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FOURTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

NEW YORK

Agricultural Experiment Station,

For the Year 1885.

WITH THE REPORTS OF THE DIRECTOR AND OFFICERS.

TRANSMITTED TO THE LEGISLATURE JANUARY, 1886.

ROCHESTER, N. Y.
E. R. ANDREWS, PRINTER AND BOOKBINDER.
1886.

1885

ORGANIZATION OF THE STATION.

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Assistant,
S. D. Anderson.

Horticulturist,
Emmett S. Goff.

Assistant Horticulturist,
M. H. Beckwith.

Botanist,
J. C. Arthur, M. S.

Chemist,
S. Moulton Babcock, A. M. Ph. D.

Assistant Chemist,
E. F. Ladd, B. S.

Stenographer,
F. E. Newton.

Farmer,
G. W. Churchill.

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REPORT

OF THE BOARD OF CONTROL OF THE NEW YORK AGRICULTURAL EXPERIMENT STATION.

To the Honorable the Legislature of the State of New York:

I herewith respectfully submit, in behalf of the Board of Control, the Fourth Annual Report of the New York Agricultural Experiment Station. Its contents will explain the success which is now rewarding our efforts; and this, with the Report of the Treasurer, render unnecessary any extended remarks on my part.

Respectfully submitted,

ROBT. J. SWAN,
President.

Illinois State Laboratory of Natural History
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TREASURER'S REPORT.

GENEVA, N. Y., *December* 11, 1885.

To the Honorable the Legislature of the State of New York:

As Treasurer of the Board of Control of the New York Agricultural Experiment Station, I do respectfully report:

That I have received from the Comptroller of the State of New York, for the twelve months ending September 30th, 1885, the sum of	$19,401 65
Amount paid by the Comptroller of the State of New York for the traveling expenses of the Board of Control, for the twelve months ending Sept. 30th, 1885	598 35
Cash on hand Oct. 1st, 1884	3,447 95
Total	$23,447 95

And I do further report, That I have expended during the twelve months ending Sept. 30th, 1885, the sum of $20,085 25. Vouchers for which, duly audited by the Special Auditing Committee of the Board of Control, have been furnished the Comptroller of the State of New York

Properly classified, the expenditures have been as follows:

Salaries	$8,995 00
Labor	4,490 71
Botanical Department	74 01
Farm Implements and Tools	262 19
Freight, Cartage and Express	141 73
Fuel	58 93
Furniture	33 63
Laboratory Department	372 61
Library	74 85
Live Stock	111 00
Manure and Fertilizer	509 77
Permanent Improvement	56 79
Postage expenses	74 91
Printing	174 25
Repairs	1000 53
Scientific Apparatus	152 65
Stationery	263 71
Sundries	160 38
Supplies	721 32
Tenement House	1742 44
Travel	443 98
Insurance	169 86
Total Expenditures	$20,085 25

And I do further Report, That I have received during the twelve months ending Sept. 30th, 1885, from the Director of the State Experiment Station, for Produce of said Station sold, the sum of $780.41, which said sum of $780.41 has been duly paid over to the Treasurer of the State of New York

WM. SLOSSON,
Treasurer.

Report of the Director.

To the Board of Control of the New York Agricultural Experiment Station.

GENTLEMEN.—I herewith submit my fourth annual report, for the calendar year 1885.

The year upon the whole has been a favorable one for experiment, although the climatic conditions have been exceptional. The cold of the winter was severe, a drought in the spring, abundance of rainfall yet none too much during midsummer, and an excess of water in the late summer. The summary of our weather records, the details of which appear elsewhere, may be consulted in the tables below; the assumed average being the twelve year records of Professor Wilson, as published in our second report.

1885.

	No. of days on which rain was recorded.	Rain. fall: inches.	Average rainfall for 12 years.
Jan.	6	1.07	1.594
Feb.	5	0.61	1.138
Mar.	3	0.12	1.888
Apr.	8	1.26	3.375
May	13	1.58	2.933
June	9	2.49	2.121
July	6	4.64	3.281
Aug.	17	5.02	3.690
Sept.	5	2.11	2.499
Oct.	12	2.88	3.122
Nov.	12	1.36	2.254
Dec.	7	0.76	2.027

July 7..........1.94 in. in 5 hours.
Aug. 21–22 .....2.02 in. in 4 hours.

The temperature records show the greatest heat and greatest cold recorded during any one month, the mean of the highest and lowest daily readings, and the mean of the three daily readings from which is derived the mean temperature of each month, which last is to be compared with the twelve year average.

	Greatest heat °F.	Greatest cold °F.	Mean of max. temp.	Mean of min. temp.
Jan.	52	–6	29.8	11.5
Feb.	38	–12	21.7	0.9
Mar.	48	–11	27.1	10.3
Apr.	84.5	20.5	50.7	31.6
May	81.7	27.5	64.7	44.
June	86.5	41.5	74.1	52.9
July	90.5	46.5	79.5	59.8
Aug.	85.5	45.0	73.7	56.3
Sept.	83.7	40.0	69.2	48.6
Oct.	79.0	25.0	58.2	40.2
Nov.	68.0	18.0	45.5	33.0
Dec.	53.0	4.0	35.0	20.5

	Mean air temperatures. Standard Time.			1885 mean monthly temp. °F.	12 years average mean monthly temp. °F.
	A. M.	N.	6 P. M.		
Jan.	18.9	23.1	21.1	21.05	25.29
Feb.	9.9	17.1	14.9	13.99	25.39
Mar.	17.1	23.4	22.0	20.86	32.26
Apr.	37.6	47.5	45.0	43.37	43.21
May	50.6	60.8	60.3	57.27	55.66
June	60.0	70.2	68.7	66.33	64.93
July	65.8	76.4	74.7	72.31	70.28
Aug.	61.2	69.4	66.7	65.76	68.08
Sept.	53.5	66.1	61.5	60.37	60.47
Oct.	43.8	53.7	49.3	48.95	49.66
Nov.	37.4	42.6	39.8	39.93	39.12
Dec.	27.0	31.2	29.6	29.26	25.56

The averages for the seasons are as below:—

	Rainfall: inches.		Temperature.	
	1885. in.	Av. of 12 years. in.	1885.	Av. for 12 years.
Spring	2.96	8.196	40.50°	44.21°
Summer	12.15	10.092	68.13°	67.68°
Autumn	6.55	7.875	49.75	49.52°
Winter		4.759		25.41°
		30.922		47.20

The hottest average for the day, in the twelve years records, was July 20, 1884, when the mean temperature was 84.7°. In 1885, the hottest average day was July 17, the mean temperature recorded being 83.5°.

The coldest average day for the twelve years was –14.2 on Feb. 6, 1885. On Feb. 11, 1885, the mean temperature for the day was –5.58°.

The hottest and coldest points reached during the 12 years were 96.5° and –18.5°; the hottest and coldest recorded in 1885 were July 17, 90.5° and Feb. 12, –12°.

Through the ingenuity of Mr. Babcock, an apparatus was prepared for recording the hours of sunshine. The details of the observations and a description of the apparatus will appear elsewhere, but the summary of the results may find place here.

	Hours of sunlight recorded.	Possible hours of sunshine (approximate)	Per cent. sunshine recorded.	Per cent. of Cloud.
May	214	453	47.3	52.7
June	281	457	61.5	38.5
July	289	462	62.6	37.4
Aug.	207	428	48.3	51.7
Sept.	231	373	62.0	38.0
Oct.	136	341	39.9	60.1
Nov.	53	293	18.1	81.9
Dec.	50	284	17.7	82.3

The peculiarity of the plant growing of the season has been the luxuriant growth of the foliage, especially marked in the Cucurbitaceous plants and in tomatoes. What the relative influences towards this result of moisture, temperature, or actinism must remain unknown until our records are more complete.

Our soil thermometers were placed in the ground on April 10, but were maliciously destroyed during the night of April 20. We were unable to procure new instruments until June 12, and these were for a different depth than those heretofore in use, a matter of regret, as also the break in our records.

That the one factor of temperature alone is insufficient for the purpose of noting the relations of climate to growth may be illustrated by two varieties of corn, the one early the other late, noting the days between vegetation and bloom, and the sum of the mean temperatures of each day during this interval. It will be seen that while the earlier variety required more heat units in 1885, the later variety required less.

Waushakum corn (Flint)

	Planted.	Vegetated.	Bloomed.	Days between Veg. and Bl.	Sum of mean daily temp. bet. veg. and bl.
1883	May 16	May 28	July 23	56	3727°
1884	“ 19	“ 26	“ 21	56	3659°
1885	“ 18	“ 28	“ 27	60	4103°

Chester Co. mammoth (Sweet)

	Planted.	Vegetated.	Bloomed.	Days between Veg. and Bl.	Sum of mean daily temp. bet. veg. and bl.
1883	May 16	May 28	Aug. 10	74	5117°
1884	“ 19	“ 26	“ 14	80	5268°
1885	“ 18	June 1	“ 10	70	4850°

The explanation of such discrepancies as shown in the above tabular statement may be looked for in actinic records, had such been kept during the years preceding the present, but the most important use of these figures is to call attention to the necessity of careful and scientific meteorological and climatic studies as an aid to enable us to predict from local studies of plant growth and cropping what may be expected to occur in other regions whose climatic conditions are known.

The lysimeter records have been kept as usual during the year. The value of these observations must arise through the length of their continuance, and hence we shall postpone their discussion until a later date. When these records are discussed, the results will doubtless prove of value as throwing some light upon the subject of nitrification within the soil, but the influence of cultivation upon the checking of evaporative changes in the soil can at present be readily read from the figures which are given in the chemist's report.

The subject of the nomenclature of our agricultural plants is one of prime importance, and much work has been devoted to this matter, as also to the connected question as to what points in our vegetables are diagnostic; that is, what points of description there are which are stable as against the changes induced by season and fertility of the soil. The botanist is able to identify a variety of plant, without regard to whether the plant is depauperate or vigorous, and it seems reasonable to infer that equal success may be expected in our study of agricultual varieties. The more our experience with cultivated plants, the firmer our belief is in the stability of types of varieties, and our observations all tend to prove the importance of variety to the grower, and the necessity of identification as preliminary to the recommendation of any one sort. In the report of the horticulturist will be found much descriptive matter, as well as experimental determinations which are well worth the careful attention of the progressive agriculturist.

The subject of "duplicates" is one which is deserving even of a tedious discussion, as the whole value of our deductions derived from plat work must be based on this study. Single or even multiple trials extending over but few seasons are incapable of telling which is the better of two fertilizers used until we can interpret correctly the divergences which occur between crops grown upon plats arranged for and treated as duplicates, and even where this difficulty is surmounted we must wisely recognize what of our results are local only, and what can be used for purposes of generalization. The whole matter of fertilization experimentation upon the plat system is one which must be studied carefully for many years before we can even hope to advance beyond the present illusory position which is so befogging to the public, and whose published results are often so belittling to experimenters. Such results as are obtained may however prove of service in formulating future advance if the figures gained are grouped and studied in accordance with the teachings of the mathematics of averages and probabilities, and if corrected in accordance with the influences that may be logically ascribed to the physical conditions of moisture, temperature and actinism. This view of the position inculcates the idea that the same area of plat cannot be equally efficacious for different sorts of plants, but that the number of plants under observation must be a leading factor, and that the areas used must be so diversified as to give for each trial a sufficient number of plants to allow of the application of the mathematical doctrine of equalization through which extremes appear equally upon either side of the mean, and accidental results can thus be eliminated from the conclusion. The doctrine of chances must enter into agricultural studies to a greater extent than has been customary, before we can secure results which will admit of safe generalization. That the Station has not carried out these views in full is only to be explained by the fact that the method is yet under study, and our circumstances do not yet admit of close application.

The report of the botanist is noteworthy from the conclusions arrived at with reference to the cause of pear blight; the difficulties attending this investigation can only be appreciated by experts, but the success of the demonstration cannot be questioned by the pear-grower. The investigation of various rots, rusts and scabs to which vegetation is subject will, it is thought, ultimately prove of high value.

In the chemist's report will be found the evidence of much work accomplished. Especial attention has been directed towards milk analysis and treatment with reference to the influence of the food of the cow upon the milk in its food and churning relations. A list of food analyses made during the year, and combined in a table with the results of previous years, are also given, as well as other work of a miscellaneous character. The lysimeter water analyses, as well as that of water collected from our drains and from the stream, are put upon record for future use and discussion.

The work of our Assistant Chemist upon the artificial digestion of fodders, and also his investigations upon the action of phosphoric acid in fertilizers deserve especial notice; the first subject has given results of great promise, and forecasts the time when the value of cattle foods can be directly determined in the laboratory under conditions which are under exact control.

The weather records have been under the direct charge of our first assistant, and have been conscientiously recorded. The study of the cereals by Mr. Plumb has occupied much of his attention, and is a work which has been much required. His descriptions as given in his report are of interest and of value as forecasting the results toward which this year's effort stands in the form of progress.

Our feeding experiments are reported quite fully ; these, however, must be regarded rather as marking progress than as complete. The method of interpretation used seems the proper one, and attention is called here to this method as obviating the danger of cancellation in the use of figures gained from unequal condition and relations of the animal and the food under the circumstance of practise. If our ideas are correct, true incorporation of figures into averages which shall define the laws of nutrition can only take place when the conditions are either gaining or losing, and such periods require separate study. Hence our choice is few animals carefully studied as individuals, rather than many animals studied in mass.

Our Horticulturist's report is as usual, largely tabular. These tables represent much labor, and it is believed will prove ultimately of use, when the subject of agricultural botany becomes more of a study than at present. We desire to put data upon record, which becoming cumulative from year to year, will in time allow of our horticultural work being reviewed and studied with reference to the influences exerted by climate, soil and selection. Some of the experimental work here reported is worthy of serious examination by the farmer and gardener, as giving valuable clues which being followed out promise to conduct to a knowledge of certain conditions which can be influenced towards contributing to our success. Each year we propose to devote some space to descriptive and nomenclature work ; in 1882 and 1883 we had beans, in 1884 maize and peas, in this report lettuce and certain cereals, but this work, as much other, must be considered rather as progressive than as complete.

The Assistant Horticulturist makes a report upon roots, as supplementary to a like study in 1884. This investigation seems to have important bearings upon the study of fertilization and rotation, but many more observations are required before there can be safety in generalization, for we have not as yet investigated the distinct influences of soil and manure upon the rooting habits of plants. At present it will not be surprising if their appears to be contradiction between results reported for the same species of plant from year to year.

The study of agriculture is a complex one, involving chemical, physical, biological, mathematical, and personal factors, and each branch of science must be called upon for assistance in common problems under investigation, and there must necessarily be no strict divisions into departmental work. The various subdivisions of our working force being for convenience of administration only are not allowed to act as a barrier against co-operative work. The laboratory is under the charge of the chemist, but any member of our staff can go there for assistance or to obtain the use of facilities for his work, and our chemist in turn has the garden, the field, and the farm at his disposal. The whole staff have equal rights and privileges, and I am happy to report that now for four years harmony has existed, and the spirit of mutual helpfulness has been ever present, thus adding very much to the efficiency of the Station, and to the easing of my own multiple and often involved duties. I trust that with accumulated material, and with the continuance of the *esprit de corps* of my assistants the time may soon come when the subordinate relations of the part to the whole shall become better defined in our reports, which at present are allowed to appear fragmentary in their character.

DONORS.

Among our friends we are under especial obligation to Messrs. Vilmorin, Andrieux & Cie, seedsmen of Paris, who have placed at our disposal already for several years, free of cost not only such seeds as they keep in stock, but as well their personal service in procuring seed not on the market. The seed procured from them serve us as standards for our comparisons, not alone from their high quality and general trueness to name, but also because they represent varieties described in that admirable volume by the Messrs. Vilmorin, entitled "Les Plantes Potageres." We cannot refrain from mentioning also the liberality and friendliness of Messrs. Thorburn & Co., seedsmen of New York, who have not alone refused all payment for whatsoever orders we have placed with them, but have also freely supplied us with articles of interest, and have held themselves ready to respond to such calls for information as we have found useful to make. We are also under renewed obligations to those other seedsmen whose names appear in our list of donors, and if we do not mention them more particularly it is only because circumstances have not led us to take advantage of their willingness to accommodate. It speaks well for seedsmen that they are ever willing to aid us and to profit by our work, and that they seem desirous that we shall be outspoken in our comments upon the quality and purity of their wares.

We have received, in 1885 :

Jan. 7. Of J. J. DeForest, Duanesburg, N. Y., one file of "The Husbandman," nearly complete.

Jan. 7. Of Duryea Starch Manufacturing Co., Glen Cove, Long Island, 8 bbls. starch feed.

Jan. 7. Of Department of Agriculture, Washington, D. C., sorghum seed and oats, and at various other times during the year packages of seed wheat and rye.

Jan. 22. Of Hiram Sibley & Co., seedsmen, Rochester, N. Y., a fine assortment of field and garden seeds; also Mar. 21, ten varieties of seed oats ; also Sept. 3, seven varieties of seed wheat.

Jan. 26. Of Dr. H. Lassing, New York, "mochu gornu," or "male rice," from Japan.

Jan. 27. Of J. M. Thorburn & Co., seedsmen, New York, N.Y., a fine collection of seed, together with the privilege of ordering seeds free of cost selected from their large stock ; also April 8, a tuber of the "Thorburn" potato ; also May 4, one hundred and thirty packets of flower seeds, etc.

Jan. 27. Of Peter Henderson & Co., seedsmen, New York, a collection of seeds.

Jan. 27. Of D. Landreth & Sons, Seedsmen, Philadelphia, Pa., a collection of seeds ; also May 8, tubers of the wild potato.

Feb. 17. Of Prof. L. B. Arnold, Rochester, N. Y., grape seeds from single seeded grapes from bunches nearly seedless.

Feb. 23. Of Jos. Breck & Son, Seedsmen, Boston, the free filling of an order for seed.

Mar. 16. Of J. G. Swan, Port Townsend, W. T., a collection of seeds.

Mar. 16. Of W. B. Jones & Co. Seedsmen, Herndon, Ga., a fine assortment of Cow pea seed.

Mar. 16. Of J. A. Everitt, Seedsmen, Watsontown, Pa., packets of garden seeds.

Mar. 18. Of Dr. Edward Palmer, Smithsonian Institution, Washington, D. C., samples of the corn grown by the Cocopa Indians.

Mar. 19. Of A. H. Moss, Wellsburg, N. Y., samples of hybridized tobacco seed.

Mar. 19. Of W. L. Herschey, Landisville, Pa., one stone fork.

Mar. 21. Of Barak Wright, Highlands, N. C., one packet of apple seed.

Mar. 25. Of Messrs. Vilmorin, Andrieux & Cie, Seedsmen, Paris, France, two hundred and forty six varieties of vegetable seeds ; also in October, forty nine varieties of commercial wheats, with the privilege of selection from their hundreds of samples collected from all quarters of the globe.

Mar. 31. Of American Glucose Company, Buffalo, N. Y., twelve barrels of sugar meal or wet feed.

Mar. 31. Of John O'Donnell, Jamaica, N. Y., four barrels of Acme fertilizer.

Apr. 13. Of Prof. W. R. Lazenby, Director of the Ohio Agricultural Experiment Station, Columbus, their 3rd Annual Report ; also May 1, three varieties of Strawberry plants for experimental use.

Apr. 13. Of F. H. Horsford, Seed grower, Charlotte, Vt., one packet Horsford's Market Garden Pea ; also Aug. 22, two packets of seed wheat.

Apr. 14. Of Howecroft and Watkins, Seedsmen, London, Eng., thirty-two large packets of vegetable seeds.

Apr. 14. Of H. N. Smith, seed grower, South Sudbury, Mass., one packet of Extra Early Peas.

Apr. 22. Of Pringle & Horsford, Seed growers, Charlotte, Vt., one packet of peas.

Apr. 27. Of J. T. Lovett, nurseryman, Little Silver, N. J., six plants of Miller's Woodland Raspberry.

May 2. Of J. F. Tillinghast, Seedsman, LePlume, Pa., seven packets of cabbage seed ; also Sept. 12, one package of Tillinghast's Cabbage Pest Powder.

May 4. Of A. Reger, Somerville, N. J., one hand fertilizer and insecticide distributor.

May 7. Of C. L. VanDeusen Nursery Company, Geneva, N. Y., four varieties of strawberry, seven of raspberry, and five of grape vines.

May 15. Of J. C. Robinson, Belcher, N. Y., one tuber of seedling potato "No. 7."

May 18. Of Chas. W. Garfield, Sec'y, Grand Rapids, Mich., Reports of the Secretary of the Michigan Horticultural Society for 1884.

May 18. Of Hon. J. W. Wadsworth, M. C., Geneseo, N. Y., vol's. IX, X and XI, U. S. Census of 1880.

May 22. Of T. H. Hoskins, Newport, Vt., two packets of new seed peas of his own production ; also May 27, packets of various seed beans.

May 29. Of D. Bouck, Lockport, N. Y., ears of "California" and "Scoharie" sweet corn.

Aug. 6. Of O. H. Alexander, Charlotte, Vt., two packets of seed wheat.

Aug. 16. Of John Lovel, Driffield, Yorks, England, plants of Filbert Pine Strawberry (5-leaved).

Aug. 29. Of R. G. Cuist, New Market, Ind., four packets of wheat.

Aug. 31. Of Prof. S. F. Baird, Sec'y, Smithsonian Institution, Washington, D. C., Report for 1883.

Aug. 31. Of Prof. C. W. Dabney, Director, Report of the N. C. Agricultural Experiment Station for 1884.

Aug. 31. Of D. M. Ferry & Co., Seedsmen, Detroit, Mich., five packets of wheat.

Sept. 16. Of Patterson Bros., Windfall, Ind., packets of wheat.

Sept. 20. Of Nash & Bro., Millington, N. J., one Acme harrow.

Oct. 1. Of G. A. Dietz, Chambersburg, Pa., packets and heads of wheat.

Oct. 1. Of R. Johnson, Shortsville, N. Y., raspberry and strawberry plants of new varieties.

Oct. 13. Of Prof. H. E. Blount, Fort Collins, Col., a collection of small packets of seed wheat.

Oct. 13. Of Prof. Wm. Trelease, Sec'y, Transactions of the Wisconsin State Horticultural Society for 1885.

Oct. 16. Of R. G. Baird, Sec'y, Michigan Board of Agriculture Report, 1884.

Nov. 9. Of ——, Report of the Wisconsin Agricultural Experiment Station for 1884.

BULLETINS.

During the year Bulletins No. CVII to CXV, old series, have been issued in slips to newspapers, stations, colleges, and a few gentlemen interested in agricultural research. July 18, we commenced a new series, in sheet form, as we find a general desire among recipients that they might appear in a form more suitable for preservation. Up to date we have issued No. I to VI, of the new series.

Our Bulletins have been freely copied by the press, as we have heard of their appearance in many papers which we do not see. Those papers in which we have seen their use are in the subjoined list:—

American Cultivator, Boston, Mass.
American Farmer, Baltimore, Md.
American Garden, Greenfield, Mass.
American Grange Bulletin, Cincinnati, O.
American Rural Home, Rochester, N. Y.
American Seedsman, LaPlume, Pa.
Boston Weekly Post, Boston, Mass.
Brewers Journal, New York, N. Y.
Budget, Babylon, N. Y.
Country Gentleman, Albany, N. Y.
Delaware Dairyman and Register, Franklin, N. Y.
Dunkirk Journal, Dunkirk, N. Y.
Farm, Field & Stockman, Chicago, Ill.
Farmer, Malone, N. Y.
Farmer & Dairyman, Syracuse N. Y.
Farmers Advocate, London P. O., Can.
Farmers Review, Chicago, Ill.
Geneva Advertiser, Geneva, N. Y.
Geneva Chronicle, Geneva, N. Y.
Geneva Courier, Geneva, N. Y.
Geneva Gazette, Geneva, N. Y.
Hearthstone, Farm and Nation, Philadelphia, Pa.
Home Farm, Augusta, Me.
Husbandman, Elmira, N. Y.
Maryland Farmer, Baltimore, Md.
Massachusetts Plowman, Boston, Mass.
National Live Stock Journal, Chicago, Ill.
New England Farmer, Boston, Mass.
New England Homestead, Springfield, Mass.
New York Weekly Tribune, New York, N. Y.
New York Weekly World, New York, N. Y.
Orange County Farmer, Port Jervis, N. Y.
Orchard & Garden, Little Silver, N. J.
Our Country Home, Greenfield, Mass.
Pacific Rural Press, San Francisco, Cal.
Phelps Citizen, Phelps, N. Y.
Practical Farmer, Philadelphia, Pa.
Rochester Democrat and Chronicle, Rochester, N. Y.
Rural New Yorker, New York, N. Y.
Southern Cultivator, Atlanta, Ga.
Southern Planter, Richmond, Va.
Weekly Press, Philadelphia, Pa.

GLUCOSE OR STARCH WASTE AS CATTLE FOODS.

The object of these feeding experiments commenced Dec. 11, 1884, is to determine the value of the wastes of the glucose and starch factories as a food, when used in the fresh, acid, and dried condition. These foods appear upon the market under various names.

The "wet feed" or "corn feed" or "starch feed" or "slump" is the first or raw waste from the manufacture of starch or glucose, it being that part of the maize grain from which the starch has been removed, and is sold in its wet state, more or less freed from the water of manufacture, but always wet and freed from a portion of the gluten of the grain. It presents a not unattractive appearance when fresh, and is subject, upon exposure, to an acid fermentation, which is said to pass at times into the putrefactive, but no putridity was developed with us during the season it was kept stored for use, and used.

The "dry feed" or "starch meal" is the "wet feed" brought to a dry state before being sold, by the evaporation of the water, and often more or less of the gluten which has been removed added to the dry product. It is a yellow, flaky or bran like product, sweet and well tasted, and being dry, is subject to no acid or putrefactive changes.

The "gluten meal," not fed in these experiments, is the glutinous portion of the starch waste, roughly separated from the gross waste, and whose removal leaves the wet feed. It is dried and ground and appears in the market in the form of a handsome yellow meal, sweet and pleasantly flavored.

The analyses of these various products, as made at the Station, together with that of the hay and corn meal which entered into these experiments, are as below :

	Hay.	"Wet feed" Duryea Starch Co.	"Wet feed" Am. Glucose Co.	"Dry feed" Av. of 3 analyses. Duryea Starch Co.	Corn meal. Waushakum Flint Corn.	Gluten meal From Chicago	Gluten meal From Am. Glucose Co.
Water	14.13	68.51	65.50	12.59	15.80	7.31	8.25
Ash	6.16	.21	.18	.67	1.05	.74	.86
Albuminoid (N.x.6.25)	10.36	6.55	4.31	16.09	10.31	28.03	30.16
Crude fiber	29.38	2.07	4.29	8.22	1.58	.73	2.44
Nitrogen-free extract	36.88	18.69	22.46	56.72	67.64	54.46	53.13
Ether extract (Fat)	3.09	3.97	3.26	5.71	3.62	8.73	5.16

The cattle used were two native cows, Ceres and Juno purchased in new milk, and landed at the station Dec. 10, 1884. They were at once placed in the experimental barn, in which they were kept until April, without exercise ; but in April were turned out daily on pleasant days into a small paddock from which all feed had been carefully removed. These cattle were weighed daily each morning before being fed or watered, and their food and water was weighed to them, and the unconsumed portions, if any, carefully collected and weighed, the difference between the weighings thus giving the amount of food consumed. The cattle scales weigh to the pound ; the feed scales, upon which each milking was also weighed, turn with one quarter of an ounce.

The feeding trials can be divided into periods, as follows:—

Period I. Dec. 2 to Dec. 24, 1884. Hay ad libitum.
Period II. Dec. 25 to Jan. 24, 1885. Duryea's "Wet feed" ad libitum, and then hay ad libitum. The "wet feed" of this trial contained 0.193 per cent of free acid calculated as acetic, or expressed in vinegar from 3 to 6 per cent.
Period III. Jan. 25 to Feb. 5. Hay ad libitum.
Period IV. Feb. 6 to Feb. 27. Hay and "Dry feed," the hay ad libitum.
Period V. Feb. 28 to Mar. 21. Hay and "Dry feed," to which 200 cc. of an acetic acid solution was added, about equivalent to the acid fed daily during Period II.
Period VI. March 22 to Mar. 30. Hay and "Dry feed," to which 400 cc. of an acetic acid solution was added, about equivalent to twice the acid fed daily during Period II.
Period VII. Apr. 1 to Apr. 22. Hay and the American Glucose Co's "Wet Feed," the feed in a sweet condition.
Period VIII. Hay ad libitum, and 8 lbs. corn meal.

The daily data, during these periods, is given in a tabular form in the tables which follow:—

PERIOD I. (Hay)

1884.	Food Consumed.							
	Weight of Cows		Hay.		Water Drank		Milk Yield.	
Dec.	Ceres lbs.	Juno lbs.	Ceres lbs.	Juno lbs.	Ceres lbs.	Juno lbs.	Ceres lbs.	Juno lbs.
11								
12	719	959	20.0	20.0	89.6	80.9	19.7	17.3
13	749	970	25.0	25.0	77.6	77.5	21.6	20.6
14	757	987	23.0	24.0	89.7	72.1	21.4	20.9
15	770	985	20.0	20.0	84.0	82.9	22.5	21.0
16	770	985	23.7	23.8	61.9	65.8	22.2	20.7
17	754	978	19.2	19.4	87.7	67.0	20.5	20.4
18	768	973	24.2	24.0	67.0	56.1	20.1	19.7
19	763	971	19.6	19.6	69.2	45.9	20.5	19.7
20	759	947	24.3	24.1	68.2	96.3	19.8	19.2
21	761	974	23.6	23.8	75.9	60.1	19.2	19.2
22	761	958	19.0	18.9	68.2	74.1	20.0	19.7
23	752	950	24.0	23.2	80.5	71.8	18.9	18.7
24	772	965	21.5	21.2	84.3	55.4	20.5	20.0
	771	945	21.5	21.4	77.4	86.4	20.9	19.8
14 ds	759	967	22.0	22.0	77.2	70.9	20.6	19.8

PERIOD II. (Hay and acid "wet feed")

Dec.										
25	769	955	19.6	5.0	14.4	15.0	73.6	50.3	19.3	18.7
26	767	949	19.4	9.0	14.6	17.0	76.6	57.0	19.9	20.7
27	772	948	24.2	10.0	19.6	17.0	65.2	52.4	21.3	21.1
28	773	949	16.5	10.0	14.5	19.0	63.8	40.4	21.6	21.4
29	762	940	19.5	10.0	14.5	21.0	63.3	50.9	23.0	22.9
30	752	941	19.5	15.0	14.4	23.0	85.1	48.6	22.1	22.7
31	768	937	14.7	15.0	14.3	25.0	57.0	50.8	22.7	23.7
Jan.										
1	751	943	16.5	15.0	9.6	27.0	65.5	28.8	24.0	24.6
2	754	925	16.7	15.0	9.8	29.0	62.6	40.9	24.4	25.1
3	754	927	24.7	20.0	11.8	31.0	63.4	40.7	24.2	25.3
4	759	931	19.4	25.0	11.5	33.0	64.2	35.2	24.7	25.1
5	760	933	14.6	25.0	7.6	35.0	68.6	24.9	25.4	27.0
6	763	917	10.9	22.0	6.9	37.0	51.3	44.1	25.4	26.4
7	743	917	18.9	20.0	6.9	39.0	78.9	31.2	24.9	24.8
8	755	912	3.9	28.0	0.9	62.7	89.4	64.1	24.7	24.4
9	772	948	11.9	20.0	9.0	3.0	45.4	15.9	24.2	24.4
10	741	896	5.0	35.0	5.0	40.0	47.9	63.9	27.2	22.6
11	732	926	5.0	28.7	5.0	40.0	39.2	13.0	26.6	24.6
12	719	899	15.0	10.0	5.0	45.0	56.0	42.6	26.4	25.6
13	725	904	9.9	30.0	9.7	20.0	62.6	41.9	24.9	25.8
14	741	897	4.9	30.0	4.9	30.0	17.7	16.8	27.9	24.2
15	713	878	4.9	19.6	5.0	40.0	43.7	42.8	26.4	25.3
16	708	896	14.9	8.6	9.8	10.0	53.1	41.6	23.1	24.5
17	717	885	19.8	14.2	12.7	20.0	67.2	72.6	22.7	22.0
18	739	916	9.9	19.2	9.9	10.0	55.0	40.8	25.6	23.6
19	735	893	8.0	23.8	8.0	25.0	22.6	23.6	27.0	21.0
20	708	874	13.0	19.7	13.0	25.0	66.4	65.6	25.5	21.8
21	731	906	13.0	15.7	12.8	30.0	63.0	63.6	26.2	23.3
22	736	914	13.0	12.0	9.6	30.0	38.3	41.5	26.1	26.2
23	715	911	14.8	13.0	9.8	30.0	63.9	41.8	24.6	26.4
24	733	908	9.9	25.0	9.9	30.0	35.0	35.7	25.2	25.6
31 ds	744	919	13.9	18.3	10.0	27.7	58.2	41.4	24.4	23.9

PERIOD III. (Hay)

Food Consumed.								
	Weight of Cows		Hay.		Water Drunk		Milk Yield.	
	Ceres lbs.	Juno lbs.	Ceres lbs.	Juno lbs.	Ceres lbs.	Juno lbs.	Ceres lbs.	Juno lbs.
Jan.								
25	718	890	19.9	15.0	67.6	71.0	25.4	25.0
26	730	908	29.8	19.8	59.5	90.2	21.6	20.9
27	748	920	19.7	19.9	79.6	52.5	20.0	19.1
28	753	912	20.0	20.0	55.2	53.0	21.6	19.0
29	714	910	24.4	19.7	81.7	53.4	19.0	18.9
30	755	907	19.9	19.7	60.6	61.1	19.8	18.0
31	744	914	23.0	19.4	82.3	58.9	17.9	18.2
Feb.								
1	755	906	19.6	19.5	59.9	53.3	21.5	18.2
2	743	896	19.4	19.7	97.5	102.8	17.6	17.0
3	755	933	24.6	19.7	89.2	48.8	18.0	17.3
4	768	905	24.7	19.1	94.1	35.2	18.7	17.0
5	767	866	24.1	19.7	88.2	113.7	18.2	17.4
12 ds	746	905	22.4	19.9	76.2	66.1	19.9	18.8

PERIOD IV. (Hay and "dry feed")

Feb.										
6	766	920	15.0	8.0	15.0	8.0	69.0	48.0	21.5	17.0
7	751	896	14.9	8.0	10.1	8.0	26.4	0.6	21.2	18.4
8	703	841	15.0	8.0	10.0	8.0	105.9	108.7	19.8	16.3
9	749	899	19.9	8.0	10.0	8.0	86.7	35.9	22.2	19.1
10	765	880	14.9	8.0	15.0	8.0	73.6	66.1	23.4	19.4
11	759	900	17.0	8.0	16.8	8.0	65.4	43.0	22.9	19.5
12	756	893	16.9	8.0	12.6	8.0	67.4	22.4	24.9	20.0
13	745	858	16.5	8.0	11.8	8.0	74.3	61.4	24.2	19.7
14	745	875	16.5	8.0	9.7	8.0	67.7	66.4	24.0	19.9
15	745	891	19.8	8.0	16.4	8.0	86.1	83.6	24.6	20.0
16	751	915	19.6	8.0	14.7	8.0	72.0	52.4	25.9	22.4
17	745	915	19.6	8.0	14.6	8.0	86.7	53.3	26.3	22.0
18	750	910	18.9	7.5	15.5	8.0	88.1	33.7	27.0	22.9
19	751	885	14.7	7.0	14.1	8.0	91.4	65.5	26.4	22.5
20	750	893	19.6	8.0	14.7	8.0	75.4	52.9	25.1	20.7
21	748	894	18.4	7.2	13.6	8.0	81.0	59.0	26.0	21.9
22	753	908	14.7	7.8	14.4	7.4	80.0	58.7	26.2	22.0
23	740	913	14.2	7.2	13.5	8.0	52.0	35.7	25.7	22.6
24	720	889	14.6	8.0	13.4	8.0	81.5	41.5	24.2	22.2
25	742	877	14.7	8.0	13.3	8.0	63.3	52.3	25.5	22.0
26	727	879	14.9	8.0	14.5	7.8	85.6	76.8	25.4	22.2
27	735	905	14.8	7.6	13.8	8.0	64.5	45.9	26.2	23.2
22 ds	745	893	16.6	7.8	13.5	8.0	74.7	52.9	24.5	20.7

PERIOD V. (Hay and acid "dry feed")

FOOD CONSUMED.

	Weight of Cows.		Ceres			Juno.			Water Drank.		Milk Yield.	
	Ceres lbs.	Juno lbs.	Hay lbs.	Dry Feed lbs.	Acid cc.	Hay lbs.	Dry Feed lbs.	Acid cc.	Juno lbs.	Ceres lbs.	Ceres lbs.	Juno lbs.
Feb. 28	726	895	14.9	8.0	200	11.9	8.0	200	67.6	29.2	25.9	22.2
Mar. 1	726	875	14.9	7.8	200	13.5	8.0	200	60.9	54.2	26.2	21.8
2	723	878	14.9	8.0	200	14.0	8.0	200	89.5	78.4	26.7	21.5
3	740	910	11.8	7.7	200	11.4	8.0	200	75.0	55.5	26.0	22.6
4	743	902	16.7	8.0	200	12.6	8.0	200	72.0	67.0	26.7	21.4
5	743	914	16.6	7.3	200	11.3	8.0	200	64.5	0.0	27.6	22.3
6	727	861	16.7	7.7	200	12.9	8.0	200	80.9	82.2	26.2	21.2
7	736	899	19.4	7.2	200	11.2	8.0	200	71.9	51.8	26.2	21.2
8	736	897	19.2	6.9	200	12.0	8.0	200	80.9	69.0	25.9	21.2
9	752	890	19.2	7.7	200	13.0	8.0	200	68.2	42.9	26.3	20.7
10	756	884	19.1	7.6	200	14.6	8.0	200	92.9	51.1	26.0	21.3
11	762	893	19.1	8.0	200	13.6	8.0	200	69.4	54.1	26.4	21.4
12	755	897	14.7	8.0	200	11.7	8.0	200	94.8	40.9	25.9	20.9
13	763	900	17.8	7.9	200	12.8	8.0	200	67.4	31.3	26.8	22.1
14	754	881	19.7	8.0	200	15.6	8.0	200	68.4	62.0	26.2	20.6
15	762	891	19.1	7.3	200	16.4	8.0	200	77.2	65.1	26.2	20.8
16	759	907	17.4	7.8	200	12.9	8.0	200	84.7	49.0	26.7	21.6
17	763	892	17.4	6.0	200	12.6	8.0	200	32.8	51.9	26.4	20.4
18	764	882	17.6	7.7	200	12.0	8.0	200	67.7	24.2	26.2	20.1
19	753	865	19.2	7.8	200	12.3	8.0	200	80.0	40.9	26.0	20.5
20	765	864	17.0	6.2	200	14.7	8.0	200	62.9	72.0	26.2	19.4
21	752	897	17.2	5.9	200	14.2	8.0	200	76.0	60.1	26.0	19.9
22 ds	748	890	17.3	7.5	200	13.1	8.0	200	73.0	51.9	26.3	21.1

PERIOD VI. (Hay and more acid "dry feed")

Mar. 22	760	901	14.2	4.4	400	12.8	8.0	400	65.0	60.2	25.9	19.6
23	751	896	19.3	7.6	400	14.6	8.0	400	68.7	55.0	23.9	19.6
24	760	899	14.7	7.3	400	14.6	8.0	400	70.0	44.7	24.2	19.0
25	762	890	14.6	7.7	400	14.2	8.0	400	61.2	28.0	24.6	19.1
26	753	863	19.1	8.0	400	17.0	8.0	400	75.9	105.6	23.7	18.0
27	748	915	19.2	5.5	400	17.1	8.0	400	114.9	81.2	23.5	18.7
28	782	924	14.3	6.0	400	16.4	8.0	400	81.4	49.2	24.4	20.0
29	765	914	19.6	8.0	400	16.9	8.0	400	89.0	47.9	25.6	20.2
30	766	924	19.4	7.2	400	14.5	8.0	400	85.5	64.0	25.7	19.9
9 days	761	903	17.1	6.8	400	15.4	8.0	400	79.1	59.5	24.6	19.4

PERIOD VII. (Hay and sweet "wet feed")

FOOD CONSUMED.

	Wt. of Cows.		Ceres		Juno		Water Drank.		Milk Yield	
	Ceres	Juno	Hay	Wet feed	Hay	Wet feed	Ceres	Juno	Ceres	Juno
Mar.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
31	768	928	19.2		19.0		82.6	49.3	25.0	18.9
Apr.										
1	755	908	16.0	20.0	16.1	20.0	56.7	28.8	25.1	18.4
2	748	892	15.4	25.0	14.9	25.0	72.1	71.9	24.6	17.6
3	767	928	9.9	25.0	10.0	25.0	42.7	0.0	27.0	19.3
4	735	884	1.9	0.0	9.7	25.0	0.0	35.3	18.6	19.0
5	702	880	14.9	8.0	10.0	30.0	83.6	66.1	10.7	18.5
6	748	910	9.9	20.0	9.8	32.0	62.4	42.8	18.4	19.9
7	743	922	10.0	25.0	6.4	34.0	38.0	0.0	19.7	19.7
8	727	877	8.0	27.0	6.0	36.0	46.7	33.6	22.6	20.9
9	716	886	7.0	27.0	7.0	25.0	31.2	52.1	22.5	19.6
10	706	904	9.8	25.0	10.0	25.0	34.0	23.0	21.7	19.2
11	703	889	9.9	25.0	9.9	25.0	39.4	28.9	21.5	18.1
12	700	886	7.9	25.0	8.0	30.0	23.9	0.0	21.6	18.2
13	690	858	10.0	25.0	7.0	30.0	41.4	59.1	20.9	16.3
14	698	903	11.9	25.0	9.4	30.0	49.9	15.6	21.3	17.1
15	714	890	11.9	25.0	6.6	30.0	47.1	29.0	22.0	17.7
16	721	891	11.9	25.0	5.8	30.0	38.6	28.6	22.5	16.7
17	721	887	12.6	25.0	5.8	30.0	40.9	0.0	22.4	15.9
18	721	862	12.8	25.0	5.9	28.4	81.3	60.8	22.6	14.7
19	742	888	11.8	25.0	7.0	12.4	65.5	30.2	22.1	14.0
20	740	870	11.7	25.0	9.6	25.0	56.6	56.4	21.9	13.2
21	735	892	11.3	25.0	9.8	30.0	58.5	46.7	22.8	13.9
22	732	905	7.1	25.0	6.1	24.0	87.2	46.6	22.0	16.1
22 ds	726	891	10.6	22.8	8.7	27.4	49.9	34.3	21.6	17.5

PERIOD VIII. (Hay and corn meal.)

Apr.										
23	736	890	9.0	8.0	6.9	8.0	72.2	64.0	22.1	15.4
24	728	890	9.5	8.0	9.8	8.0	76.7	47.6	22.9	15.0
25	729	886	13.6	8.0	9.9	8.0	75.2	51.9	23.9	14.9
26	712	870	11.8	8.0	9.9	8.0	59.6	28.3	22.9	14.7
27	720	862	11.8	8.0	10.5	8.0	61.9	55.4	22.6	14.5
28	712	874	11.9	8.0	6.8	8.0	71.0	56.2	21.0	13.5
29	716	875	11.9	8.0	9.0	8.0	53.2	22.6	21.4	13.3
30	711	857	13.7	8.0	10.0	8.0	75.4	71.9	19.9	13.3
May										
1	716	880	14.6	8.0	12.0	8.0	56.4	35.5	21.6	14.2
2	704	872	14.3	8.0	9.7	8.0	84.0	63.3	20.8	14.0
3	722	888	11.8	8.0	9.9	8.0	58.2	46.2	21.7	14.6
4	709	878	11.9	8.0	10.0	8.0	67.1	50.8	20.7	15.1
5	713	879	12.8	8.0	9.9	8.0	10.2	0.0	21.3	15.4
13 ds	717	877	12.5	8.0	9.6	8.0	63.2	45.7	21.7	14.5

PERIOD I. (Hay)

	Yield.		Analysis.				By Churn. Butter.	
	A. M. Milk.		Fat.		Milk Solids.			
	Ceres lbs.	Juno lbs.	Ceres %	Juno %	Ceres %	Juno %	Ceres %	Juno %
Feb.								
16	11.9	12.2	4.44	5.05	13.50	13.78	4.14	4.82
18	12.0	11.5	4.35	4.74	12.94	13.53	4.10	4.51
20	11.4	10.8	4.10	4.34	12.98	12.68	4.01	3.63
22	10.2	10.4	4.21	4.87	13.27	13.38	4.26	4.13
24	12.0	11.5	4.06	4.66	13.01	13.48	3.77	4.34
Aver.	11.5	11.3	4.23	4.73	13.14	13.37	4.06	4.29

PERIOD II. (Hay and acid "wet feed")

Dec.								
26	11.6	11.1	3.89	4.19	12.83	13.02	3.48	4.51
27	11.6	12.2		4.07	12.67	12,97	3.90	3.93
28	12.0	12.4	3.62	4.03	12.59	12.77	3.77	0.00
29	13.7	13.8	4.09	4.35	13.19	12.90	3.48	2.73
30	13.2	14.0	4.05	4.26	12.42	12.85	4.29	4.50
31	13.1	14.6	4.17	3.72	12.52	12.27		
Jan.								
1	14.5	15.0	3.53	4.10	12.22	12.61	3.46	3.46
2	15.2	15.5	4.05	3.69	12.56	12.44	4.02	3.45
3	14.0	15.0	3.87		12.73	12.15	4.23	3.95
5	14.2	16.4	5.49	5.14	12.61	12.46	4.43	2.08
8	15.7	16.4		4.19	12.75	12.93	3.87	4.18
9	15.1	14.7	4.23	3.55	12.60	12.47	3.92	3.26
10	16.7	14.0	3.08	3.94	12.74	12.43	3.73	2.43
12	17.1	16.2	3.76	3.56	12.90	12.53	3.98	3.24
13	15.1	16.4	3.62	3.91	12.84	12.24	3.46	3.22
14	17.0	16.2	3.40	3.00	12.56	12.28	3.13	2.53
15	16.9	17.4	3.95	3.83	13.18	12.87	3.82	3.44
16	15.4	15.4	3.67	3.58	12.69	12.61	3.51	0.00
19	16.6	13.4	3.29	3.66	12.11	12.68	3.12	3.56
21	15.6	14.6	3.80	3.80	12.96	12.91	3.77	3.31
24	15.6	15.6	3.56	3.33	12.67	13.90	3.63	3.01
Aver.	14.8	14.8	3.85	3.89	12.68	12.68	3.75	3.04

PERIOD III. (Hay)

Jan.								
26	14.4	12.9	3.52	3.97	12.93	13.01	3.43	3.27
28	13.3	11.9	3.60	3.85	12.31	12.70	3.20	3.17
30	11.7	11.2	3.31	4.19	12.25	13.19	3.72	3.45
Feb.								
2	11.2	10.9	3.66	4.35	12.57	13.24	3.61	4.27
Aver.	12.6	11.7	3.52	4.09	12.51	13.03	3.49	3.54

PERIOD IV. (Hay and "dry feed")

	Yield.		Analysis.				Butter. By Churn.	
	A. M. Milk.		Fat.		Milk Solids.			
	Ceres lbs.	Juno lbs.	Ceres %	Juno %	Ceres %	Juno %	Ceres %	Juno %
Feb.								
7	13.3	11.7	3.36	3.37	12.17	12.52	3.05	2.80
9	13.4	12.2	3.58	4.28	12.33	13.37	3.72	3.97
12	14.0	11.9	3.75	4.08	12.51	12.76	3.65	3.97
14	14.5	11.5	3.73	4.57	12.68	13.16	3.57	3.97
16	16.2	14.7	3.97	3.53	12.99	11.97	3.20	4.02
18	16.7	15.0	3.58	3.70	12.67		3.77	3.77
19	15.9	13.7	3.65	3.68	12.77	12.54	3.57	3.20
21	15.2	13.4	3.64	3.63	12.52	12.45	3.32	3.42
23	15.1	13.6	3.59	3.50	12.90	12.50	3.85	3.41
25	15.4	13.0		3.46	12.55	12.79	3.77	3.53
26	15.1	13.1	3.64	3.79	12.91	12.96	3.25	3.33
Aver.	15.0	13.1	3.65	3.78	12.64	12.70	3.52	3.58

PERIOD V. (Hay and acid "dry feed")

Feb.								
28	15.2	12.9	3.94	3.72	13.07	13.07	4.10	3.35
Mar.								
2	15.9	12.5	3.63	4.10	12.81	13.17	4.35	4.45
4	15.6	12.9	3.67	3.52	12.75	12.19	3.82	3.25
6	16.9	13.5	3.51	3.45	12.61	12.26	3.45	2.85
7	16.6	12.9	3.26	3.86	12.12	12.70	3.25	3.40
9	16.0	13.7	3.48	3.84	12.39	12.58	3.45	3.55
10	16.4	13.2	3.40		12.92	12.11	3.50	3.07
12	15.7	13.4	3.59	3.70	12.92	12.76	3.45	3.17
14	16.3	13.2	3.28	3.97	12.16	13.10	3.25	3.75
16	16.0	12.4	3.66	3.64	12.82	14.00	3.32	2.85
18	16.1	11.6	3.33	3.69	12.41	12.46	3.20	3.32
20	16.5	12.1	3.23	3.77	12.34	12.88	3.12	3.57
Aver.	16.1	12.9	3.50	3.75	12.61	12.77	3.52	3.38

PERIOD VI. (Hay and more acid "dry feed")

Mar.								
23	15.5	12.5	3.50	3.82	12.95	12.76	3.00	3.00
24	14.4	12.2	3.29	4.10	12.56		3.47	3.47
26	14.9	10.9	3.13	3.30	12.77	13.77	4.00	3.55
28	14.5	12.6	3.47		12.19	13.38	3.32	2.87
30	15.8	12.6	3.44	3.77	12.48	12.39	3.25	3.32
Aver.	15.0	12.2	3.37	3.75	12.59	13.07	3.41	3.24

PERIOD VII. (Hay and meal "wet feed")

	Yield.		Analysis.				Butter by Churn.	
	A. M. Milk.		Fat.		Milk Solids.			
	Ceres lbs.	Juno lbs.	Ceres %	Juno %	Ceres %	Juno %	Ceres %	Juno %
Apr.								
1	15.9	11.6	3.74	3.50	12.62	12.27	3.67	3.00
3	14.0	10.6	3.23	3.10	12.27	12.37	0.00	2.95
6	10.9	12.6	4.16	3.88	13.41	12.80	0.00	3.22
8	13.5	12.7	3.64	3.82	13.35	13.23	3.87	3.07
10	13.9	12.1	4.12	3.68	13.42	12.76	4.35	3.20
13	13.7	10.7	4.08	4.26	13.40	13.74	4.37	4.25
15	14.0	11.8	4.31	5.29	13.56	14.00	6.10	8.37
17	14.0	9.6	3.98	4.23	13.10	13.38	4.42	3.67
20	13.6	7.9	4.29	3.87	13.64	13.93	3.95	3.47
22	13.3	10.3	4.00		13.81	14.08	5.37	4.07
Aver.	13.7	11.0	3.95	3.96	13.26	13.26	3.61	3.93

PERIOD VIII. (Hay and corn meal)

Apr.								
26	14.2	9.6	3.61	4.03	12.92	12.79	5.15	4.77
27	13.9	9.2	3.25	3.33	12.70	12.07	2.45	2.87
29	13.9	8.3	3.62	3.83	13.15	12.86	4.87	3.40
May								
1	13.4	9.0	3.11	3.01	12.73	11.88	2.90	1.97
2	13.2	9.1	3.57	3.31	12.80	12.22	3.17	1.87
4	13.2	10.0	3.27	3.28	12.74	12.14	2.72	1.55
Aver.	13.6	9.2	3.40	3.46	12.84	12.33	3.54	2.74

PERIOD II. (Hay and acid "wet feed")

Dec.	P. M. Milk.							
29	9.4	9.1	5.08	5.78	13.83	14.65	4.90	4.97
Jan.								
6	10.5	10.1	4.48	5.68	13.31	14.69	4.35	5.85
17	9.6	8.0	4.43	4.86	13.95	14.31	4.75	4.67
22	9.7	10.0	4.75	4.75	13.80	13.67	5.02	4.20
Aver.	9.8	9.3	4.68	5.27	13.72	14.33	4.75	4.92

PERIOD III. (Hay)

Jan.								
31	6.6	7.2	4.28	5.36	13.24	14.20	4.82	5.62
Feb.								
2	6.7	6.8	4.11	6.24	13.69	15.15		
4	7.4	6.2	3.97	5.36	13.57	14.51	4.10	5.72
Aver.	6.9	6.7	4.12	5.65	13.50	14.62	4.46	5.67

PERIOD IV. Hay and "dry feed")

Feb.								
10	9.4	6.9	4.35	5.68	13.19	14.13	4.35	5.55
18	10.2	7.9	4.89	5.09	14.16	13.66	5.07	5.45
Aver.	9.8	7.4	4.62	5.38	13.67	13.89	4.71	5.50

PERIOD VII. (Hay and meal "wet feed")

Apr.								
4	6.6		5.06		14.11			

In these tables we cannot but notice the individuality of the cows. Juno had a less capricious appetite than Ceres, drank less water, and required less food in proportion to her live weight ; while Ceres was the better milk yielder. These facts find comparison in the following table :

Average daily record for each period.

	Wt. of cows.		Wt. of food.		Per ct. relation. Food to weight.		Wt. water drank.		Milk yield	
	Ceres. Lbs.	Juno. Lbs.	Ceres. Lbs.	Juno. Lbs.	Ceres.	Juno.	Ceres. Lbs.	Juno. Lbs.	Ceres. Lbs.	Juno Lbs.
Period I.	759	967	22.	22.	2.9	2.3	77.2	70.9	20.6	19.8
II.	744	919	32.2	37.7	4.3	4.1	58.2	41.4	24.4	23.9
III.	746	905	22.4	19.9	3.0	2.2	76.3	66.1	19.9	18.8
IV.	745	893	24.4	21.5	3.3	2.4	74.7	52.9	24.5	20.7
V.	748	890	24.8	21.1	3.3	2.4	73.0	51.9	26.3	21.1
VI.	761	903	23.9	23.4	3.1	2.6	79.1	59 5	24.6	19.4
VII.	726	891	33.4	36.1	4.6	4.1	49.9	34.3	21.6	17.5
VIII.	717	877	20.5	17.6	2.9	2.0	63.2	45.7	21.7	14.5

The hay fed was of excellent quality, and when mixed foods were fed, a different proportion was consumed by the two cows. We hence supplement this table by another, in which the amount of albuminoid consumed daily is calculated, and the average fat in the morning and evening milk is given, but there were fewer analyses of the evening than of the morning's milk, which destroys the comparison except as between the two cows.

	Albuminoid consumed in ration.		Per cent. of fat in morning's milk.		Per cent. of fat in evening's milk.		Per ct. of butter churned from morning's milk	
	Ceres. Lbs.	Juno. Lbs.	Ceres.	Juno.	Ceres.	Juno.	Ceres.	Juno.
Period I.	2.28	2.28	4.23	4.73			4.06	4.29
II.	2.64	2 84	3.85	3.89	4.68	5.27	3.75	3.04
III.	2.32	2.06	3.52	4.09	4.12	5.65	3.49	3.54
IV.	2.97	2.68	3.65	3.78	4.62	5.38	3.52	3.58
V.	2.99	2.64	3.50	3.75			3.52	3.38
VI.	2.86	2 88	3.37	3.75			3.41	3.24
VII.	2.08	2.08	3 95	3.96			3.61	3.93
VIII.	2.12	1.82	3.40	3.46			3.54	2.74

Calculating the various rations into their equivalent in hay, we find that the albuminoid which represents 24.4 lbs. of hay, or 3.3 per cent. of her average live weight sufficed to maintain Ceres under the conditions of the trial, with an average daily milk yield of 23.3 lbs ; while the albuminoid equivalent to 23.2 lbs of hay, or 2.6 per cent. of her live weight sufficed to maintain Juno under the conditions of the trial, with an average daily milk yield of 20.2 lbs.

When we consider the teaching of our tabular data, that even when fed *ad libitum*, neither is the same amount of food eaten by the two cows, nor the same amount by the same cow during successive intervals, it is seen that we have not figures which can justly be incorporated into averages for the two cows, and hence we must examine, as to the influence of the food, the records of each cow separately. If we do otherwise, and average our results, the figures in many cases cancel each other, instead of becoming incorporated. Thus if one of the two cows has a strong appetite, and feeds largely, while the other cow has a capricious appetite and refuses her food, the union of the data of the two into averages tends to destroy the value of co-relations which might appear between the food and the yield, whether expressed or live weight or milk.

Hence to rightly study our data, we must examine the co-relations between each cow and her food, and must eliminate the influence of that portion of each period which may be considered as a transition period from one food to the next. To do this, in our case, we shall ignore the first four days after each change of food, and calculate our data upon nine days feeding for each food.

The milk yielded by a cow is dependent upon hereditary characteristics, and upon the more or less remoteness from the period of calving, the tendency being for the milk flow to decrease with the distance from calving. In order to determine this normal decrease, we have tabulated the milk records of forty native cows and forty Ayrshire cows for the five months from calving, with the following for average results :—

	Average yield per month. Lbs.				
From calving.	1st mo.	2d mo.	3d mo.	4th mo.	5th mo.
40 Native Cows	790	727	657	587	518
40 Ayrshire Cows	898	822	745	673	594
Av. for 80 cows	844	774	701	630	556

From this table we find that when the average yield per day was 28 lbs. for the first month, the yields were 26, 23, 21, and 18 lbs. for the second, third, fourth and fifth thirty days respectively, or an average decrease of about two pounds monthly from the average yield of each month. If we were dealing with a large herd, we could therefore assume that when there is no appearance of falling off in milk yield, as between two successive periods, that the maintenance of the equality of the yield is strong evidence of the action of the food supplied being favorable to milk yield, even when no actual increase followed its use. When we study individual cows, however, we cannot express the normal decrease in milk yield by any one figure, but can say only that two pounds decrease in the average yield between two successive periods of thirty days each, is as likely to be correct as any other figure that can be offered, and that probably the loss is no less. This circumstance relating to milk yield must be borne in mind in the interpretation of our tables, even if we cannot give accurate expression in figures.

The following table, calculated for nine day periods must furnish the material from which our conclusions in regard to the influence of the food fed upon our cattle are to be derived.

Average for Each Cow in Nine Day Periods. CERES.

		Food Consumed.								
	Weight of Cow. lbs.	Hay lbs.	Acid Wet feed lbs.	Dry feed lbs.	Acid c.c.	Sweet Wet feed lbs.	Corn Meal lbs.	Water drunk lbs.	Milk yield lbs.	A. M. Milk fat ℔ ct.
Period I. Dec. 16–24..	762	21.9						74.4	20.0	4.23
II. *a.* Dec. 29, Jan. 6	758	17.4	18.0					64.6	24.0	4.18
b. Jan. 7–15.	738	8.8	24.6					53.4	25.9	3.67
c. Jan. 16–24	725	12.9	16.8					51.6	25.1	3.58
III. Jan. 28, Feb. 5	750	22.2						78.7	19.1	3.52
IV. *a.* Feb. 10–18	751	17.7		7.9				75.7	24.8	3.76
b. Feb. 19–27	741	15.6		7.6				75.0	25.6	3.63
V. *a.* Mar. 4–12	746	17.8		7.6	200			77.3	26.4	3.47
b. Mar. 13–21	760	18.0		7.2	200			68.6	26.3	3.37
VI. March 22–30	761	17.1		6.9	400			79.1	24.6	3.37
VII. *a.* April 5–13	715	9.7				23.0		44.5	20.0	4.00
b. Apr. 14–22	725	11.4				25.0		58.4	22.2	4.14
VIII. Apr. 27, May 5	714	12.7					8.0	59.7	21.2	3.36

Average for Each Cow in Nine Day Periods. JUNO.

		Food Consumed.								
	Weight of Cow. lbs	Hay lbs.	Acid Wet feed. lbs	Dry feed lbs.	Acid c.c.	Sweet Wet feed lbs.	Corn Meal lbs.	Water drunk lbs.	Milk yield lbs.	A. M. Milk fat lbs.
Period I. Dec. 16–24	962	21.7						68.1	19.6	4.73
II. *a.* Dec. 29, Jan. 6	933	11.2	29.0					40.5	24.7	4.21
b. Jan. 7–15	908	5.7	35.5					36.9	24.6	3.71
c. Jan. 16–24	900	10.6	23.3					47.4	23,8	3.59
III. Jan. 28, Feb. 5	905	19.6						64 5	17.8	4 13
IV. *a.* Feb. 10–18	893	14.1		8.0				53.6	20.6	3.97
b. Feb. 19–27	894	13.8		7.9				54.3	22 1	3.61
V. *a.* Mar. 4–12	893	10.3		8.0	200			52.0	21.3	3.67
b. Mar. 13–21	889	13.7		8 0	200			50.7	20.6	3.77
VI. Mar. 22–30	903	15.4		8.0	400			59.5	19.3	3.75
VII. *a.* April 5–13	890	8.2				29.7		34.0	18.9	3.91
b. Apr. 14–22	888	7.3				26.6		34.9	15.5	4.46
VIII. Apr. 27, May 5	874	9.8					8.0	44.7	14.2	3.35

Average constituents fed daily, in lbs.

	Water.		Ash.		Albuminoid.		Crude fibre.		Nit-free Ext.		Ether Ext.	
	Ceres.	Juno.	Cer.	Ju.	Cer.	Ju.	Cer.	Ju.	Cer.	Ju.	Cer.	Ju.
Period I.	3.09	3.07	1.35	1.34	2.27	2.25	6.43	6.37	8.08	8.00	.68	.67
II. *a.*	14.79	21.45	1.11	.75	2.98	3.06	5.48	3.89	9.78	9.55	1.26	1.50
b.	18.09	25.13	.59	.42	2.52	2.92	3.10	2.40	7.85	8.74	1.25	1.59
c.	13.33	17.46	.82	.70	2.44	2.63	4.14	3.59	7.90	8 26	1.07	1.26
III.	3.14	2.78	1.37	1.20	2.30	2.03	6.52	5.76	8.19	7.23	.68	.60
IV. *a.*	3.49	2.99	1.14	.92	3.10	2.75	5.85	4.80	11.01	9.74	1.01	.90
b.	3.17	2.94	1.01	.90	2.84	2.70	5.20	4.70	10.06	9 57	.92	.89
V. *a.*	3 48	2 45	1 15	.68	3.06	2.36	5.85	3.69	10.87	8.34	.99	.78
b.	3.44	2.94	1.16	.89	3.03	2.71	5.88	4.68	10.72	9.60	.97	.88
VI.	3.29	3.18	1.10	1.00	2.89	2.89	5.59	5.18	10.22	10.22	.92	.93
VII. *a.*	16.44	20.62	.64	.55	1.99	2.13	3.84	3.68	8.74	9.69	1.05	1.23
b.	17.98	18.81	.74	.65	2.26	2.17	4.42	4.02	9.82	9.58	1.18	1.17
VIII.	3.06	2.65	.86	.68	2.14	1.84	3.86	3.01	10.09	9.02	.69	.60

We note first the indications of the separate individuality of our two cows. As between Periods I. and VIII. Ceres shows a loss of 48 lbs. in live weight, or 6 per cent.; Juno a loss of 88 lbs., or 9 per cent. Ceres a gain in milk of 1.2 lbs., Juno a loss of 5.4 lbs. If we compare the three periods of nine days each, or Period II. *a*, *b*, and *c*, we find the figures for live weight to be 758,738 and 725 lbs. for Ceres, or an indication of gradual decline; to be 933,908 and 900 lbs for Juno, also an indication of losing weight. In the milk records, 24.0, 25.9, and 25.1 lbs. the average milk yield for Ceres during these periods; 24.7, 24.6, and 23.8 lbs. the average milk yield for Juno, certainly not correspondences, and we are hence led to seek whether the effects marked are not from the amount of food eaten, rather than from the character of the food. We hence arrange our foods in order of magnitude of albuminoid fed, as in the following table:

CERES.				JUNO.			
Albuminoid consumed. lbs.	Period.	Milk yield. lbs.	Live wt. lbs.	Albuminoid consumed. lbs.	Period.	Milk yield. lbs.	Live wt. lbs.
3.10	IV. *a.*	24.8	751	3.06	II. *a.*	24.7	933
3.06	V. *a.*	26.4	746	2.92	II. *b.*	24.6	908
3.03	V. *b.*	26.3	760	2.89	VI.	19.3	903
2.98	II. *a.*	24.0	758	2.75	IV. *a.*	20.6	893
2.88	VI.	24.6	761	2.71	V. *b.*	20.6	889
2.84	IV. *b.*	25.6	741	2.70	IV. *b.*	22.1	894
2.52	II. *b.*	25.9	738	2.63	II. *c.*	23.8	900
2.44	II. *c.*	25.1	725	2.36	V. *a.*	21.3	893
2.30	III.	19.1	750	2.25	I.	19.6	962
2.27	I.	20.0	762	2.17	VII. *b.*	15.5	888
2.26	VII. *b.*	22.2	725	2.13	VII. *a.*	18.9	890
2.14	VIII.	21.2	714	2.03	III.	17.8	905
1.99	VII. *a.*	20.0	715	1.84	VIII.	14.2	874

From these figures we see indicated a certain relationship between the amount of albuminoid in the food and the milk yield, the figures varying from the correspondence in places, but in general conforming, especially if the influence of the time from calving be estimated; while the co-relation between the albuminoid and the live weight is not equally as well marked in the two cows.

We may infer from these tables that the amount of albuminoid fed had more influence than the character of the food, as between the waste products of the starch and glucose manufacture, while the character of the food had an influence upon the production of milk. One effect seems, however, well marked. The addition of the acid seemed favorable to the maintenance weight, and not unfavorable to milk yield but to a slight degree, if at all.

		CERES.			JUNO.		
Feed.	Periods.	Albumin. consumed lbs.	Milk yield lbs.	Live wt. lbs.	Albumin. consumed lbs.	Milk yield lbs.	Live wt. lbs.
Hay feed	I and III	2.28	19.5	756	2.14	18.7	933
Hay and meal	VIII	2.14	20.0	715	1.84	14.2	874
Acid "feed"	II, V and VI	2.82	25.4	748	2.41	21.8	904
Sweet "feed"	IV and VII	2.55	23.1	733	2.44	19.3	891

We may also compare the adjoining periods of nine days each of acid feeding, as V. *b* and VI.

		CERES.			JUNO.		
	Period.	Albumin. con.	Milk yield	Live wt.	Alb. con.	Milk yield	Live wt.
Hay, dry feed & 200 cc. acid	V. *b*	3.03	26.3	760	2.71	20.6	889
Do. 400 do.	VI.	2.88	24.6	761	2.89	19.3	903
Hay, dry feed, no acid	IV. *a*	3.10	24.8	751	2.75	20.6	893
Do. do.	*b*	2.84	25.6	741	2.70	22.1	894
Av'r'ge of 18 days, acid feed		2.95	25.4	760	2.80	19.9	896
Do. sweet feed		2.97	25.2	746	2.72	21.3	893

Before studying into the actual results obtained, we must remind that as a general rule a milch cow loses weight after calving, and this rule is so marked that in our own experience a good milch cow always shows a tendency to "milk thin" even under most nutritious feeding, while the poor milch cow shows a tendency to gain in live weight under similar feeding. It is probable that in most of our periods a full maintenance ration was being fed, and that the apparent loss of weight was due rather to this law, than to the character of the food, and we may reasonably suppose from our data, that the loss was even less than would have occurred had a previously ascertained maintenance ration been fed. It is difficult to interpret accurately the meaning of our figures upon live weight. If the average amount of water drunk daily be subtracted from the average live weight of the various periods, the difference in the weighings becomes less marked.

The figures, as obtained, read, however, for the various periods :

			Ceres.			Juno.		
No. of days average.	Feed.	Period.	Alb. fed. lbs.	Live wt. lbs.	Milk yield. lbs.	Alb. fed. lbs.	Live wt. lbs.	Milk yield. lbs.
18.	Hay.	I and III.	2.28	756	19.5	2.14	933	18.7
9.	Hay and meal.	VIII.	2.14	715	20.0	1.84	874	14.2
45.	Hay and "wet feed."	II and VII.	2.43	732	23.4	2.58	904	21.5
45.	Hay and "dry feed."	IV, V and VI.	2.98	752	25.5	2.68	894	20.8

It is thus seen that so far as these experiments go, the wastes of the starch and glucose manufacture, under whatsoever names sold, are a useful and advantageous cattle food.

The influence of the foods upon the quality of the milk is not readily ascertained. We have a number of analyses of the morning milk, but the variation in quality from day to day is marked. Such figures as we have can be formulated as below :

	Ceres.			Juno.		
Period.	No. analyses.	Av. morning milk yield, lbs.	Per ct. fat.	No. analyses.	Av. morning milk yield, lbs.	Per ct. fat.
I and III	9	12.0	3.92	9	11.5	4.44
VIII	6	13.6	3.40	6	9.2	3.46
II and VII	27	14.4	3.92	27	13.7	3.95
IV, V and VI	23	15.6	3.48	22	12.9	3.74

We have here the same fat percentage in Ceres' milk under Hay feeding and Hay and "wet feed," and more fat under Hay and "dry feed" than under Hay and meal feeding. In Juno, on the contrary, the largest per cent. of fat is under hay feed, the next under hay and "wet feed," the next under hay and dry feed, and the least under hay and meal feeding. An examination of the figures in detail, will convince, we think, that it will be difficult to trace a relation between the food and the percentage of fat in the milk, and the conclusion seems justifiable that the food during the various periods was about equally potent towards maintaining the richness of the milk.

The conclusion justified by these trials must then be :

1. Starch or glucose refuse, sold under the names of wet feed, dry feed, starch meal, glucose meal and sugar meal was a valuable food for milch cows, when fed in connection with hay.

2. Its value in practice varied with the amount of albuminoid contained in the ration, of which the starch food forms an important constituent.

3. The results interpreted under the ruling of the law of tendency to loss of live weight in milking cows must be considered as indicating excellent value towards the maintenance of live weight.

4. The results indicate a tendency in this food towards stimulating the milk yield.

5. When our results are interpreted under the ruling of the general law that increase of milk yield is co-relative with decrease of fat percentage, we cannot say from our figures but that the richness of the milk was dependent upon the individuality of our cows, and that the milk fat showed any well recognized change arising from the character of the food.

6. The acidity of the food was not distinctly detrimental to its value either for maintenance or milk, but on the contrary the effect of the acid seemed favorable toward increasing the appetite and establishing increase of live weight.

Just before the completion of the experiments recorded above, we received four bags of ground hull and ground germ, the waste of a new process for utilizing the corn grain, and fed this food for thirteen days. Calling this feeding Period IX, we have for comparison Period VIII, in which nearly precisely equivalents of albuminoid and nitrogen-free extract was consumed, and nearly double the oil.

The daily data, during Period IX, is as below :—

Period IX.

	Weight of Cows,		Food consumed.				Water drunk		Milk yield.		Fat in Milk	
			Hay	Meal waste	Hay	Meal waste						
	Ceres.	Juno.	Ceres.		Juno.		Ceres.	Juno.	Ceres.	Juno.	Ceres.	Juno
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	₩ ct.	₩ ct.
May 6	671	830	11.8	8.0	9.9	8.0	99.4	90.9	18.6	13.8		
7	719	881	13.7	8.0	10.0	8.0	58.4	50.2	21.0	13.9	3.35	3.91
8	702	891	13.8	8.0	10.0	8.0	73.6	44.3	21.2	14.4		
9	725	886	13.7	8.0	10.9	8.0	64.2	57.0	21.6	13.9	4.08	3.72
10	706	887	13.7	8.0	12.0	8.0	55.0	36.1	20.6	13.4		
11	717	869	14.5	8.0	12.8	8.0	64.1	56.7	19.7	12.7	4.53	4.44
12	715	871	14.5	8.0	11.4	8.0	76.6	74.0	19.4	12.7		
13	721	883	13.2	8.0	10.4	8.0	60.6	60.2	19.7	12.1	4.28	4.33
14	709	884	13.8	8.0	11.7	8.0	85.6	66.2	19.2	12.7		
15	718	886	13.6	8.0	11.4	8.0	70.2	63.7	19.4	12.5	4.04	3.88
16	706	881	12.6	8.0	10.2	8.0	92.3	86.0	19.2	12.9		
17	713	888	11.6	8.0	11.4	8.0	88.7	71.2	18.6	13.4		
18	715	887	11.9	8.0	10.6	8.0	80.0	64.7	20.0	12.8	3.78	4.48
Average	711	879	13.3	8.0	11.0	8.0	74.5	63.1	19.9	13.2	4.01	4.12
Average for the last nine days :—												
	713	882	13.3	8.0	11.3	8.0	74.8	64.3	19.5	12.8	4.16	4.28

Analysis of the ground hull and germ (maize):

Water	7.44.
Ash	1.75.
Albuminoid (N. x. 6.25)	8.71.
Crude fibre	8.80.
Nit.-free extract	63.58.
Ether extract (fat)	9.72.

The amount fed daily, in lbs. of the various constituents of the food, for the nine days of Periods VIII and IX, was as below :—

	Period VIII.		Period IX.	
	Ceres.	Juno.	Ceres.	Juno.
Water, lbs.	3.06	2.65	2.44	2.18
Ash, lbs.	.86	.68	.95	.84
Albuminoid, lbs.	2.14	1.84	2.07	1.87
Crude fiber, lbs.	3.86	3.01	4.59	4.03
Nit.-free extract, lbs.	10.09	9.02	9.96	9.25
Fat, lbs.	.69	.60	1.19	1.13

We thus see, that during the two periods about the same amount of albuminoid was consumed, viz : 2.14 lbs. and 2.07 lbs. by Ceres ; 1.84 lbs. and 1.87 lbs. by Juno ; nearly the same amount of nitrogen-free extract, viz : 10.09 lbs. and 9.96 lbs. by Ceres ; 9.02 lbs. and 9.25 lbs. by Juno ; and much more fat, viz : .69 lbs. and 1.19 lbs. by Ceres ; .60 lbs. and 1.13 lbs. by Juno, and we can hence state the two rations as equivalents in all but the fat.

The average daily weight of the cows in Periods VIII and IX, are 714 lbs. and 713 lbs. for Ceres ; and 874 lbs. and 882 lbs. for Juno ; we hence see the two rations were equivalents for maintaining live weight, with possibly a slight gain for Period IX.

The average daily milk yields in Periods VIII and IX are 21.2 lbs. and 19.5 lbs. for Ceres ; and 14.2 lbs. and 12.8 lbs. for Juno. As the normal decrease in milk yield arising from difference in calving may be quite the decrease as noted, we cannot infer absolutely any inferiority or superiority of the two rations in this respect.

The increase in the fat percentage of the mornings milkings, from 3.36 per cent. to 4.01 per cent. in the case of Ceres ; and from 3.35 per cent. to 4.12 per cent. in the case of Juno, we cannot but associate with the increase of the fat fed daily in the food. This interpretation is outlined in our other feeding trials, but from the nature of the case is not distinctly shown in our averages.

An Experiment on Calf Feeding.

On July 14, two heifer calves were purchased, five weeks old, of common stock, but evidently short horn grades. The one called "White Face" weighed 92 lbs., and the one called "Red" weighed 93 lbs. In the afternoon fed 8 lbs. of sweet milk to each. From this date to July 31, sweet milk alone was fed, equal quantities being offered to each calf daily.

The daily weighings, and the amount of milk consumed are represented in the following table :

			Milk consumed.			
	Live weight. lbs.		"White Face."		"Red."	
	"White Face."	"Red."	lbs.	ozs.	lbs.	ozs.
July 14	92	93	8	0	8	0
" 15	92	92	8	0	8	0
" 16	94	95	18	12	12	12
" 17	92	91	13	10	13	10
" 18	92	95	13	0	13	0
" 19	94	95	13	13	13	13
" 20	96	97	16	5	16	5

	Live weight, lbs.		Milk consumed.			
	"White Face."	"Red."	"White Face."		"Red."	
			lbs.	ozs.	lbs.	ozs.
" 21	97	97	18	0	18	0
" 22	101	100	18	0	18	0
" 23	105	104	18	0	18	0
" 24	102	105	18	0	18	0
" 25	108	106	18	0	18	0
" 26	108	109	16	0	16	0
" 27	109	113	18	0	18	0
" 28	113	115	18	0	18	0
" 29	116	118	18	0	18	0
" 30	116	118	18	0	18	0
" 31	120	116	20	0	16	0
Aug. 1	123	117				

The weighings of the calves were made each morning before being fed, and hence apply to the effect of the food of the preceding day. An inspection of the record shows that it may be studied in two divisions, the one represented by under 14 lbs. of sweet milk fed, and the other by over this quantity. Averaging, therefore, the weighings which represent the feeding periods from July 14 to 19 and July 20 to 31, we have :—

JULY 14–19.

Animal.	Average weight.	Extreme weights.	Av. milk daily consumed.	Extremes of daily milk consumed.
"White Face"	93.3 lbs.	92 to 96 lbs.	12.5 lbs.	8 to 13.8 lbs
"Red"	94.1 lbs.	91 to 97 lbs.	11.5 lbs.	8 to 13.8 lbs

JULY 20–31.

Animal.	Average weight.	Extreme weights.	Av. milk daily consumed.	Extremes of daily milk consumed.
"White Face"	109.8 lbs.	97 to 123 lbs.	17.9 lbs.	16.3 to 20 lbs
"Red"	109.8 lbs.	97 to 118 lbs.	17.5 lbs.	16.3 to 18 lbs

The progress of these two animals are so nearly parallels that we can average the figures gained :—

AVERAGE FOR THE TWO CALVES.

	Average weight.	Average of extreme weights.	Apparent gain.
July 14–19	93 7 lbs.	91.5 lbs. and 96.5 lbs.	5 lbs. or 13 ozs. per day
July 20–31	109.8 lbs.	97 lbs. and 120.5 lbs.	23.5 " or 31 ozs. per day

Or

	Average milk fed daily.	Av. per cent. of milk fed daily to live weight.	Av. daily gain.
July 14–19	12 lbs.	12.8	0.83 lbs
July 20–31	17.7 lbs.	16.1	1.96 lbs
July 14--31	15.8 lbs.	15.1	1.58 lbs

These figures have this instruction. The excess of milk above a certain quantity has a greater value as expressed in gain than the preceding quantities, or otherwise expressed, only the quantity fed in excess of what is required for maintenance is expressed in increase of live weight. If these figures be interpreted exactly, which process of interpretation is allowable for illustration, as 12 lbs. of milk fed daily gave .83 lbs. daily increase of live weight, and 17.7 lbs. of milk gave 1.96 lbs. daily increase of live weight, then 5.7 lbs. of increase of milk in ration gave 1.13 lbs. of gain in live weight, or the average daily gain of live weight per pound of milk fed in the 12 lb.

ration was 1.1 oz., and the average daily gain of live weight per pound of milk fed in the 17.7 lb. ration was 1.8 oz., while for the whole period the average daily gain of live weight per pound of milk fed in the 15.8 lb. ration was 1.6 ozs.

The conclusion, therefore, seems justifiable that it is impossible to express the ratio between a pound of milk fed and the increase in growth of the calf, as so much depends upon the quantity fed, and the condition of the animal. We can ascertain, however, the relation between the amount fed and the apparent gain in any given case, and in the present trial the maximum gain for the two calves was about one pound of live weight to eight and eight-tenths lbs. of sweet milk fed during the last twelve days.

On August 1, a mixture of grain was commenced to be fed, in addition to the milk, and on Sept. 6 the milk was omitted. The daily live weights, and the daily amounts fed are shown in the appended table :

		Live weight, lbs.	
		"White Face"	"Red"
Aug.	1	123	117
	2	129	117
	3	129	122
	4	130	127
	5	131	127
	6	136	130
	7	137	133
	8	137	132
	9	138	132
	10	141	135
	11	145	138
	12	145	135
	13	147	133
	14	145	135
	15	152	136
	16	156	142
	17	156	141
	18	159	145
	19	162	147
Aug.	20	166	149
	21	165	147
	22	167	150
	23	167	151
	24	169	148
	25	175	152
	26	177	152
	27	180	150
	28	181	155
	29	183	157
	30	185	157
	31	180	157
Sept.	1	185	157
	2	191	160
	3	191	160
	4	192	163
	5	190	160
	6	195	162
	7	194	161

The amount of food consumed daily is shown in the appended table :—

		"White Face."					"Red."				
		Milk. lbs.	Oil meal. ozs.	Ground oats. ozs.	Bran. ozs.	Green clover. lbs.	Milk. lbs.	Oil meal. ozs.	Ground oats. ozs.	Bran. ozs.	Green clover. lbs.
Aug.	1	23	3	3	6		8	1	1	2	
	2	16	2	2	8		16	2	2	8	
	3	18	1	1	6		16	1	0	0	
	4	18	4	0	0		18	4	0	0	
	5	20	4	4	0		16	4	4	0	
	6	20	8	6	0		16	8	6	0	
	7	18	8	8	0		16	8	8	0	
	8	18	8	8	0		16	8	8	0	
	9	16	12	4	0		16	12	4	0	
	10	18	16	6	0		16	14	6	0	

	"White Face."					"Red."				
	Milk lbf.	Oil meal ozs.	Ground oats. ozs	Bran ozs.	Graen clover lbs.	Milk lbs.	Oil meal ozs.	Ground oats. ozs.	Bran ozs.	Green clover lbs.
Aug. 11	18	16	4	0		16	14	4	0	
12	18	2	10	0		16	2	10	0	
13	18	10	6	0		16	4	4	0	
14	18	6	8	0		16	8	8	0	
15	18	5	7	0		16	5	7	0	
16	16	6	6	0		16	6	6	0	
17	18	5	7	2		16	5	7	2	
18	14	4	4	8		14	4	4	8	
19	14	4	4	8		14	4	4	8	
20	12	4	4	8		12	4	4	8	
21	12	4	4	8		12	4	4	8	
22	12	4	4	8		12	4	4	8	
23	12	4	4	6		12	4	6	6	
24	10	6	6	12		10	6	6	12	
25	10	4	4	8		10	4	4	8	
26	10	4	4	8		10	4	4	8	
27	10	4	4	8		10	4	4	8	
28	10	4	4	8		10	4	4	8	
29	8	4	4	8	3	8	4	4	8	3
30	8	4	4	8	3	8	4	4	8	3
31	8	4	4	8	5	8	4	4	8	5
Sept. 1	6	4	4	8	9	6	4	4	8	9
2	6	4	4	8	9	6	4	4	8	9
3	6	4	4	8	5	6	4	4	8	5
4	4	4	4	8	5	4	4	4	8	5
5	4	4	4	8	6	4	4	4	8	6
6	4	4	4	8	5	4	4	4	8	5

During these thirty-seven days on milk, etc., we have the following figures :—

	"White Face."	"Red."
Lowest live weight, lbs.	129	117
Greatest live weight, lbs.	195	163
Average live weight, lbs.	162	144
Av. daily milk consumed, lbs.	13.2	12.1
Oil meal, ozs.	5.1	5.1
Ground oats, ozs.	4.6	4.6
Bran, ozs.	5.0	4.7
Clover, lbs.	1.3	1.3

The apparent daily gain in live weight of these two calves is then 1.8 lbs. and 1.2 lbs., respectively, during this period of milk and grain feeding, as contrasted with the 1.7 lbs. and 1.4 lbs. under the milk-alone feeding. We cannot fail to note that the "Red" calf has fallen behind the "White Face" not alone in live weight, but somewhat as well in the amount of food consumed. This individuality can best appear in tabular form :—

	Live weight.		
	"White Face."	"Red."	Difference.
July 15	92 lbs.	92 lbs.	
Aug. 1	123 lbs.	117 lbs.	6 lbs.
15	152 lbs.	136 lbs.	16 lbs.
Sept. 1	185 lbs.	157 lbs.	28 lbs.
6	195 lbs.	162 lbs.	33 lbs.

The figures for food consumed can be arranged in another form, by which the relation between the total food consumed, and the apparent live weight gain can be studied :—

		Changes in live wt.		Apparent daily gain.	
		"White Face."	"Red."	"White Face."	"Red."
18 days.	289½ lbs. milk consumed	31 lbs.		1.72 lbs.	
	279½ lbs. milk consumed		27 lbs.		1.50 lbs.
37 days.	489 lbs. milk 12½ lbs. oil meal 10¾ lbs. ground oats 11½ lbs. Bran 50 lbs. green clover	66 lbs.		1.79 lbs.	
	446 lbs. milk 11¾ lbs. oil meal 10½ lbs. ground oats 11 lbs. Bran 50 lbs. green clover		46 lbs.		1.24 lbs.

If we value the milk at 1 cent a lb., the oil meal at 2 cents, the oats at 1½ cents, and the bran at 1 cent, we have for cost per lb. of apparent gain or increase during these two periods in which milk formed all or a portion of the ration :—

	Cost per. lb. of increase.	
	Under milk alone.	Under milk and grain.
"White Face"	9.3 cents	8.2 cents
"Red"	10.3 cents	10.8 cents
Mean	9.8 cents.	9.5 cents.

A small sum, in the latter case, should be added to cover the cost of the clover, and this would bring the cost about the same under the two feedings.

From Sept. 7 to 21, green clover and grain were fed in equal quantities to both animals, the quantity being guaged by the appetite of the smaller feeder. On Sept. 19 and 20, the grain was refused by "Red," and with this exception the feed of the two animals was alike.

The table of live weights and food is as below:

	Live weight, lbs.		Food to each.			
	White Face.	Red.	Ground oats. ozs.	Oil meal. ozs.	Bran. ozs.	Green clover lbs.
Sept. 7						
8	197	168	8	4	12	8
9	198	167	8	4	12	6
10	202	169	8	4	12	11
11	205	169	8	4	12	10

	Live weight, lbs.		Food to each.			
	White Face.	Red.	Ground oats. ozs.	Oil meal. ozs.	Bran. ozs.	Green clover lbs.
Sept. 12	205	169	8	8	8	10
13	208	175	8	8	8	10
14	203	172	8	8	8	10
15	205	175	8	8	8	10
16	203	172	8	8	8	10
17	210	176	8	8	8	10
18	204	168	8	8	8	10
19*	205	169	8	8	8	10
20*	215	182	8	8	8	12
21	212	179	8	8	8	12
22	207	175	8	8	8	10

During this period of fifteen days we have the following summary :—

	"White Face."	"Red."
Lowest live weight, lbs.	197	167
Greatest live weight, lbs.	215	182
Average live weight, lbs.	205	172
Average daily consumption, ground oats, ozs.	8	7
Oil meal, ozs.	7	6
Bran, ozs.	9	8
Green clover, lbs.	10	10

Accepting the difference between the extreme weighings as representing increase in live weight, we have for the fifteen days:

"White Face."

	Consumption.		Changes in live weight.	Apparent daily gain.
15 days.	Ground oats	7½ lbs.	18 lbs.	1.20 lbs.
	Oil meal	6½ lbs.		
	Bran	8½ lbs.		
	Green clover	149 lbs.		

"Red."

	Consumption.		Change in live weight.	Apparent daily gain.
15 days.	Ground oats	6½ lbs.	15 lbs.	1.00 lbs.
	Oil meal	5½ lbs.		
	Bran	7½ lbs.		
	Green clover	149 lbs.		

Using the same valuations as heretofore, and calling the clover 4.00 a ton, the cost of the apparent increase per lb. is 3.5 cts. for "White Face," and 3.9 cts. for "Red."

On Sept. 22 the system of feeding was changed. From this date each animal received the quantity that our judgment pronounced full feeding, but not *ad libitum* offering. The figures gained find representation in the following table, which is made from fifteen days' trial also; the grain being in all cases equal quantities of ground oats, oil meal and bran:

---

* Grain refused by "Red."

	Live weight. lbs.		"White Face."		"Red."	
	"White Face."	"Red."	Grain. ozs.	Green clover. lbs.	Grain. ozs.	Green clover lbs.
Sept. 22						
23	220	186	30	15	21	15
24	215	179	36	15	18	15
25	215	186	36	12	18	12
26	222	184	36	15	18	15
27	225	187	36	12	18	12
28	221	192	36	12	18	12
29	220	187	36	12	18	12
30	222	187	36	12	18	12
Oct. 1	221	193	36	12	18	12
2	215	187	36	12	18	12
3	226	194	36	12	18	12
4	231	200	36	12	18	12
5	235	190	36	15	18	15
6	240	200	36	25	18	20
7	235	195	36	12	18	12

During this period of fifteen days we have the following summary :—

	"White Face."	"Red."
Lowest live weight, lbs	215	179
Greatest live weight, lbs.	240	200
Average live weight, lbs.	224	190
Average daily consumption, ground oats, ozs.	12	6
Oil meal, ozs.	12	6
Bran, ozs.	12	6
Green clover, lbs.	13.6	13.3

Accepting the difference between the extreme weighings as representing increase in live weight, we have for the fifteen days :—

"White Face."

	Consumption.		Change in live weight.	Apparent daily gain.
15 days.	Grain,	33.4 lbs.	25 lbs.	1.66 lbs.
	Green clover,	205 lbs.		

"Red."

15 days.	Grain,	17.0 lbs.	21 lbs.	1.40 lbs.
	Green clover	200 lbs.		

Calculating the cost per lb. of apparent increase, as before, we have 3.6 cts, for "White Face," and 3.1 cts. for "Red."

The next period is 15 days' repetition of the last, and the figures gained are given in the following table :—

	Live weight, lbs.		"White Face."			"Red."		
	"White Face."	"Red."	Grain. ozs.	Hay. lbs.	Grass. lbs.	Grain. ozs.	Hay. lbs.	Grass. lbs.
Oct. 7								
8	241	196	36	5	12	18		12
9	240	192	48	5	8	24	5	8
10	242	194	48		8	24	5	8
11	249	198	48		15	24		15
12	249	197	48		12	24		12
13	251	198	48		15	24		15
14	248	200	48		15	24		15
15	258	205	48		20	24		20
16	257	209	48		20	24		20
17	260	210	48		20	24		20
18	257	208	48		20	24		20
19	259	208	48		20	24		20
20	252	210	48		20	24		20
21	262	208	48		20	24		20
22	265	215	48		20	24		20

During the period of fifteen days we have the following summary :—

	"White Face."	"Red."
Lowest live weight, lbs	241	192
Greatest live weight, lbs.	265	215
Average live weight, lbs.	252	203
Average daily consumption, ground oats, ozs.	15.7	7.9
Oil meal, ozs.	15.7	7.9
Bran, ozs.	15.7	7.9
Grass, lbs	18	18

Calculating our figures, as heretofore, we have :—

"White Face."

	Consumption.		Change in live weight.	Apparent daily gain.
15 days.	Grain,	44.2 lbs.	24 lbs.	1.60 lbs.
	Grass,	270 lbs.		

"Red."

	Consumption.		Change in live weight.	Apparent daily gain.
15 days.	Grain.	22.1 lbs.	23 lbs.	1.53 lbs.
	Grass,	270 lbs.		

Calculating the cost per lb. of apparent increase, as heretofore, we have 5 cts. for "White Face" and 3cts. for Red.

The average for the various periods are for each animal :—

"White Face."

	Daily feed.	Av. daily change in live wt.	Av. cost of apparent gain, per lb.	Average weight. lbs.
July 14-19	12.5 lbs. milk	.66 lbs.	18.7 cts.	93.3
July 20-31	17.9 "	2.16 lbs.	8.2 cts.	109.8
Aug. 1-Sept. 6	milk and grain	1.8 lbs.	8.2 cts.	162.0
Sept. 7-21	grain and clover	1.2 lbs.	3.5 cts.	205.5
Sept. 22-Oct. 6	grain and clover	1.6 lbs.	3.6 cts.	224.0
Oct. 7-21	grain and grass	1.6 lbs.	5.0 cts.	252.0
Average for 100 days		1.73 lbs.	6.4 cts.	

"Red."

	Daily feed.	Av. daily change in live wt.	Av. cost of apparent gain, per lb.	Average weight. lbs.
July 14–19	11.5 lbs. milk	1.00 lbs.	11.0 cts.	94.1
July 20–31	17.5 lbs. milk	1.75 lbs.	10.0 cts.	109.8
Aug. 1–Sept. 6	milk and grain	1.24 lbs.	11.0 cts.	144.0
Sept. 7–21	grain and clover	1.00 lbs.	3.9 cts.	172.0
Sept. 22–Oct. 6	grain and clover	1.40 lbs.	3.1 cts.	190.0
Oct. 7–21	grain and grass	1.53 lbs.	3.8 cts.	203.0
Average for 100 days		1.23 lbs.	8.07 cts.	

For the two animals, the average daily change in live weight was 1.48 lbs., the average cost per lb. 7.1 cts. or 296 lbs. of apparent gain cost a total of 21.03 at the valuations used. The mean data for the two animals for the various periods, is:—

	Days of trial.	Average daily food.	Apparent daily increase.	Av. cost of apparent increase.	Cost of daily ration.
July 14–19	6	12 lbs. milk	.83 lbs.	15 cts.	12.0 cts.
July 20–31	12	17.7 lbs. milk	1.95 lbs.	9 cts.	17.7 cts.
Aug. 1–Sept. 6	37	Milk and grain	1.52 lbs.	9½ cts.	14.2 cts.
Sept. 7–21	15	Grain and clover	1.10 lbs.	3¾ cts.	4.0 cts.
Sept. 22–Oct. 6	15	Grain and clover	1.50 lbs.	3⅓ cts.	5.2 cts.
Oct. 7–21	15	Grain and grass	1.57 lbs.	4⅖ cts.	6.9 cts.
Total	100		1.48 lbs.	7.23 cts.	

We may properly conclude from this trial:—1st, That on milk feed, increase of supply of milk food diminishes the cost per lb. of live weight. 2d, That the individuality of the animals fed has a marked influence, and that the animal with the best appetite furnishes the cheapest veal when properly fed. 3rd, That economy in feeding requires a careful consideration of the cost of the various food supplies, as an increased gain through extra grain may not compensate for the increased expense. 4th, That the profit of growing veal depends largely upon the price assigned to the milk, one cent a lb. milk, when fed properly meaning about nine cent veal; when fed scantily 12 to 18 cent veal, or even more.

During the various periods the following amounts of albuminoid were consumed, and the following increase of live weight noted:—

Period.	No. of days	Ration.	Albuminoid fed, lbs. White Face.	Red.	Alb. fed to 1 lb. increase. White Face.	Red.	Mean
I.	6	Milk	2.32	2.07	.58 lbs.	.34 lbs.	.46
II.	12	Milk	6.66	6.50	.26 lbs.	.31 lbs.	.28
III.	37	Milk and grain	23.01	21.69	.35 lbs.	.47 lbs.	.41
IV.	15	Grain and clover	8.96	8.41	.50 lbs.	.56 lbs.	.53
V.	15	Grain and clover	12.96	9.83	.52 lbs.	.47 lbs.	.50
VI.	15	Grain and grass	17.15	13.10	.71 lbs.	.57 lbs.	.64
Total	100		71.06	61.60			

At the valuations used, the cost of the albuminoid per lb. was:—

Period I.	32 3 cts.
II.	32.3 cts.
III.	23.7 cts.
IV.	7.0 cts.
V.	7.0 cts.
VI.	7.0 cts.

or, for mean results, 1 lb. of albuminoid in

I.	Small ration of milk, produced	2.2	lbs. of	live weight
II.	Large ration of milk, produced	3.6	"	"
III.	Ration of milk and grain, produced	2.4	"	"
IV.	Ration of grain and clover	1.9	"	"
V.	Ration of grain and clover	2.0	"	"
VI.	Ration of grain and grass	1.6	"	"
	In average of above	2.1	"	"

The evidence of this trial is hence in favor of abundant milk feeding and early stages of growth, in order to hasten the time when the milk can be replaced by a ration of moderate grain and abundance of green forage of the best quality.

Ensilage.

In 1884 the Station silo was partly filled, in order to test the question whether cut fodder could be placed in position slowly and at intervals, and yet keep as ensilage. The following data will aid in understanding the conditions of the result.

The silo is built of brick, is of rectangular form, twelve feet long, nine feet ten inches wide, and when opened, contained three feet two inches of material.

The filling commenced August 18, 1884, with corn and sorghum cut into average lengths of three-fourths inch pieces, and the amount weighed in was as below:

August 18, 3121 lbs. corn and sorghum, mixed.
" 19, 3259 " "
" 20, 6082 " " " " "

The silo was now covered and weighted, the planks being laid upon the top of the material, without the intervention of straw. On September 18th it was opened for reception of 3044 pounds of sorghum, and was then covered and weighted as before.

On June 10, 1885, the silo was opened. The top was dark and musty for about six inches down, but the ensilage below the moldy portion was in an excellent state of preservation, and would be called first-class ensilage by those who are acquainted with ensilage products. By analysis, it contained about one and one-half per cent. of acid, calculated as acetic.

From this experiment it becomes evident that ensilage can be preserved when the silo is filled gradually, as the convenience of the labor on the farm dictates, and that but little precaution need be taken in filling. The upper layer, which became musty served as a protection to the bulk of the ensilage, but the proportion of this spoilt ensilage to the whole mass, is, of course, greater in a silo of little depth than in one which is deeper. The preservation was such that nine months or more keeping seemed to be no detriment, and it was very evident that it might have remained closed even longer, without suffering harm.

When we consider that this ensilage, stored in small quantities on different days and after an interval, was equal in quality to the former product of the same silo placed in rapidly, and with the most careful precaution, it will appear that much unnecessary labor in filling the silo was employed in the past. It seems very probable that no especial pains need be taken in order to get good results, except that the silo be tight, or, in other words, that the air be excluded, and that the various fillings shall follow each other before putrefactive changes can take place from the previous fillings.

In 1885 the silo was again filled, every care being taken to do the work of filling as carelessly as could be expected even on the most ordinary farm, the experiment being to determine with how little expense a silo could be filled and the forage secured. The following amounts of forage were tumbled in in inch pieces at the dates named:

		Lbs.
Aug. 10.	Dent fodder corn	1813
11.	Pop " "	3505
12.	Flint " "	4437
13.	Flint and Sweet fodder corn	4359
19.	Pop " "	5166

Up to Aug. 28, the above fodder in the silo was not even covered. At no time had it been trampled except what was necessary in order to level. Aug. 28 the planks were laid on. Sept. 3, the planks were removed and 4759 lbs. of Amber Cane fodder dropped in. At this time the surface of the ensilage was somewhat dry, and a little decayed in some places, especially where the planks had rested rather heavily. At the depth of eight inches the ensilage was in excellent condition, but very warm and somewhat acid. Sept. 4, 5261 lbs. of Amber Cane fodder was added, leveled, and the planks laid on.

Nov. 18, the planks were removed from a portion of the silo. The upper layer of the silage was very rotten, but no putrefactive smell, the smell being rather that from a rotten and damp stump. At four inches down the silage in perfect condition, and but very slightly acid. At six inches down perceptibly warm, as also at a foot depth. Dec. 9, no change observed.

It is certainly interesting to note that silage cut and stored at intervals, and without the use of weights, should keep so well, and if this experiment is not exceptional in its results, and we know no reason why it should be, it seems to indicate that much of the expense usually attending the filling of a silo, may be escaped.

FORAGE CROPS.

The season has been a favorable one for forage crops, and hence a greater weight of growth than obtained last year. The plats used were all one twentieth of an acre, and are represented by Series C. plats 1 to 10 inclusive and 12 to 15 inclusive. Of these plats, C. 1 and 2 received each 1$\frac{11}{64}$ cords farm dung in 1882 and no fertilization in 1883 ; C. 3 and 4 received 40 lbs. of phosphate in 1882 ; C. 5 received 80 lbs. in 1882 ; C. 15 none ; C. 14 and 15 received 40 lbs. each in 1883. With these exceptions, the plats each received 20 lbs. of phosphate in 1882, 1883 and 1884, and 50 lbs. in 1885. So far as applied fertilizer is concerned, we then have C. 1 and 2 as duplicates; C. 3 and 4 as duplicates ; C. 6, 7, 8, 9, 10, 12 and 13 as duplicates.

The plats are all 2x4 rods square, and were marked off either in 9 or 18 drills per plat, and the seed sown in as near as could be equivalent quantity in each row. The plants were cut and weighed as rapidly as the crop appeared to reach a uniform stage of ripening, which may be described for the maize as at the close of the pollen fall, and in the early milk of the ears; and as at bloom for the sorghum.

For the purpose of determining the uniformity of yield, we have calculated the forage to the half-plat, and noted the difference between the halves.

		One half lbs.	Other half lbs.	Whole plat lbs.
C. 1.	Eight-rowed White Flint corn, 9 rows	1200	1126	2326
C. 2.	Sweet corn, large varieties, 9 rows	999	1034	2033
C. 3.	Queen of the Prairie Dent, 9 rows	916	897	1813
C. 4.	Pop corn, mixed varieties, 9 rows	787½	806½	1594
C. 5.	do 18 rows	985	924	1909
C. 6.	Orange Flint, 18 rows	1365	1372	2737
C. 7.	Long Island White Dent, 18 rows	838	862	1700
C. 8.	Pop corn, White Pearl, 18 rows	952½	948	1900½
C. 9.	do 9 rows	742	788½	1530½
C. 10.	do (thicker planted) 9 rows	849	887	1736
C. 12.	Early Amber Cane, 9 rows	1163½	1221¼	2384¼
C. 13.	do 9 rows	1220¼	1155	2375¼
C. 14.	do 18 rows	1353¾	1387¼	2741
C. 15.	do 18 rows	1250	1270	2520

From this table we may note the close duplication between the two halves of each crop, the variation being in no case in excess of 6⅓ per cent. from the average. In C. 13 and C. 14, Early Amber Cane, we have duplicate fertilization for four years, duplicate conditions this year, and very close duplication in results. In C. 10, C. 9, and C. 8, we have duplication in all but method of planting, and the results here show clearly that thickness of planting increased crop, as C. 9, 1530 lbs.; C. 10, thicker planting, 1736 lbs.; C. 8, much thicker planting, 1900 lbs. The evidence in favor of thicker planting can be readily separated from the table, thus :—

C. 4.	Pop corn,	9 row plat,	1594 lbs. forage.
C. 9.	do	do	1530 " "
C. 5.	do	18 row plat,	1909 " "
C. 8.	do	do	1900 " "

Av. gain by doubling the rows, 342 lbs.

The next point to remark is that the Early Amber Cane yielded more forage than did the maize. This happened likewise in 1884.

Four agricultural species of corn and one of sorghum were used this year. The average yield of the various plats were :

			Green forage, per plat.
Flint corn,	1 plat,	9 rows,	2326 lbs.
	1 plat,	18 rows,	2737 "
Sweet	1 plat,	9 rows,	2033 "
Dent	1 plat,	9 rows,	1813 "
	1 plat,	18 rows,	1700 "
Pop	3 plats,	9 rows,	1620 "
	2 plats,	18 rows,	1905 "
Sorghum	2 plats,	9 rows,	2379 "
	2 plats,	18 rows,	2630 "

The heaviest yield attained in any one case was at the rate of 27.41 tons green forage per acre for sorghum ; and 27.37 tons green forage per acre for the Orange flint corn.

Carefully collected samples from each plat were subjected to analysis, for their water contents, with the following result :—

Plat.	Per cent. water.	Date of harvesting.	Plat.	Per cent. water.	Date of harvesting.
1	86.83	Aug. 13	8	81.76	Aug. 19
2	85.87	Aug. 11	9	82.97	Aug. 19
3	84.09	Aug. 10	19	84.14	Aug. 19
4	81.95	Aug. 11	12	85.29	Sept. 3
5	69.28	Aug. 11	13	84.84	Sept. 3
6	70.74	Aug. 12	14	84.58	Sept. 4
7	84.36	Aug. 12	15	83.43	Sept. 5

These determinations need not be interpreted very closely, as many of the samples were collected necessarily during moist if not rainy weather. Whatever value they possess is to afford a clue to the dry matter harvested from each plat.

Last year our report was rather favorable towards pop corn as a forage crop ; this year the same line of reasoning would lead us to recommend the flint corn. The different style of the season, or the different number of plants which grew on our plats may account for the discrepancy. Very probably there is not enough difference between our forage corns to offset differences brought about through fertilization and distance of planting. It is within possibility that the same variety of corn would not be equally recommendable for use on a poor farm and a good farm.

CORN.

Duplicates.

For the purpose of testing how near duplicates could be obtained, plats E. 12 to 15 were selected, fertilized alike with 400 lbs. phosphate per acre, planted with the same stock of Waushakum corn, in hills 42x44 in. apart, and four plants to the hill, and were carefully tended alike, and harvested at the same time. The figures resulting appear in the following table :

		Yield.				
Plat.	No. of plants.	No. of ears. Good,	Poor.	Weight of ears. Good, lbs.	Poor, lbs.	Yield per acre. Bushels.
E. 12	637	715	88	289.2	10.0	72.3
E. 13	636	745	152	297.2	14.5	74.3
E. 14	640	750	147	290.0	12.0	72.5
E. 15	641	761	111	294.7	10.0	73.7

We have here a variation of 46 ears, and 8 lbs. per plat, or 2 bushels per acre, a very close result.

In D. 3 and 4, D. 12 and 14, D. 13 and 15, G. 2 and 4, G. 3 and 5, we have duplicate trials whose differences may be compared.

	Yield per acre. Bushels.	Difference.
D. 3	61.7	15.7
D. 4	76.4	
D. 12	67.9	2.7
D. 14	70.6	
D. 13	69.4	2.9
D. 15	66.5	
G. 6	66.4	4.2
G. 8	70.6	
G. 7	52.3	3.7
G. 9	56.0	

From this presentation we may infer that in our duplicate plantings of corn, we cannot expect to secure equivalency within 3 or 4 bushels of crop, and may have even as great divergence as 14 or 15 bushels. It hence follows that the average interpretation of differences to be ascribed to fertility or treatment on our plats, cannot be within these figures.

WHAT PORTION OF EAR TO PLANT.

For now three successive years, our experiments in planting the but, central and tip kernels of corn, have given an uniform conclusion that the tip kernels are at least not inferior for seed to the other kernels of the ear. This years experiment is in the same direction, and embraces twenty plats. Each plat was planted in nine rows, three rows of but, three of central and three of tip seed, the seed being the five but, central and tip seed of each row from the same ears. The fertilization was alike, 400 lbs. per acre of a phosphate. The variety of Corn Waushakum, in hills, four plants to a hill, the hills 44x42 inches apart.

		No. of plants growing.			Number of ears harvested.					
					Buts.		Centers.		Tips.	
Plat.		Buts.	Centers.	Tips.	Sound.	Soft.	Sound.	Soft.	Sound.	Soft,
A. 1	Upper	197	212	210	249	6	227	22	241	31
	Lower	202	214	214	200	18	204	19	207	8
2	Upper	191	214	214	205	30	240	25	219	33
	Lower	181	213	212	195	25	205	27	200	36
3	Upper	190	211	212	217	27	219	19	212	28
	Lower	195	215	209	201	41	222	39	210	35
4	Upper	202	211	210	224	15	213	14	208	36
	Lower	204	214	216	217	27	194	19	218	20
5	Upper	207	212	209	215	26	227	28	212	33
	Lower	206	209	214	225	25	198	30	210	21
6	Upper	200	213	210	210	18	217	14	204	28
	Lower	204	215	213	203	13	211	19	212	20
7	Upper	196	211	206	219	35	195	25	209	21
	Lower	207	214	212	208	16	219	17	202	16
8	Upper	194	210	205	211	18	215	40	195	25
	Lower	198	208	215	213	17	190	37	196	19
9	Upper	206	208	213	194	30	206	21	209	12
	Lower	199	211	213	185	20	192	26	216	19
10	Upper	177	213	206	193	38	218	20	206	17
	Lower	191	210	213	185	35	225	18	212	23
		3947	4238	4226	4169	480	4237	479	4198	481

From this table we observe that for each 100 plants, the

But	seed yielded	105	merchantable,	12	unmerchantable ears
Central	"	100	"	11	" "
Tip	"	99	"	11	" "

The weight of the crop harvested as ear corn, October 11–14, was:—

	Buts.		Centers.		Tips.	
	Sound.	Unsound.	Sound.	Unsound.	Sound.	Unsound.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
A. 1 Upper	79.0	0.4	89.5	1.8	91.8	3.4
Lower	72.5	1.8	76.6	1 3	79.3	1.9
A. 2 Upper	78.0	2.5	87.0	2.8	78.0	3.8
Lower	70.0	3.0	72.0	3.1	67.0	4.1
A. 3 Upper	65.8	2.3	83.3	2.3	75.3	3.1
Lower	64.6	3.9	77.9	4.0	70.2	4.5
A. 4 Upper	82.5	1.9	80.0	4.5	73.0	4.1
Lower	78.2	2.0	70.5	1 8	73.7	2.1
A. 5 Upper	74.8	2.6	81.2	2.5	78.2	3.0
Lower	75.1	2.6	71.5	3.5	72.0	2.8
A. 6 Upper	75.9	2.2	77.3	2.1	70.8	4.3
Lower	71.6	2.0	74.0	1.9	72,0	2.4
A. 7 Upper	73.6	3.3	68.8	3.0	73.2	2.0
Lower	73.9	2.3	80.7	2.3	75.5	1.5
A. 8 Upper	74.1	2.0	76.9	4.5	73.6	3.2
Lower	78.1	1.8	64.5	5.7	71.4	2,6
A. 9 Upper	69.8	3.6	75.5	2.7	79.1	2.1
Lower	68.0	2.6	70.3	3.3	79.0	1.7
A. 10 Upper	72.3	5.9	79.2	2.1	73.2	3.0
Lower	66.0	4 7	78.8	3.0	76.5	3.0
Total	1463.8	53.4	1535.5	58.2	1502.8	58.6

For this table we observe that the weight of crop from each 100 plants was for the

But seed	37.0 lbs.	merchantable,	1.3 lbs.	unmerchantable ears.
Central seed	36.2 lbs.	"	1.3 lbs.	" "
Tip seed	35.6 lbs.	"	1.4 lbs.	" "

The average weight of the merchantable ears was for the

But seed crop	5.61 ozs.
Central seed crop	5 79 ozs.
Tip seed crop	5.96 ozs.

Calculating the yield per acre, during the various trials, and calling 80 lbs. of ear corn a bushel, we have for actual yields,—

	Yield of but, central and tip corn kernels, in bushels, per acre.				
	1882.	1883.	1884.	1885.	Average.
But seed	62.9	53.8	54.7	54.9	56.6
Central seed	62.5	54.5	56.1	57.6	57.6
Tip seed	64.7	57.1	56.3	56.3	58.6

We are hence justified in the belief that the tip kernels from good ears are as good for crop as the central kernels, where flint corn is used. It may be so with other races, but our trials have been confined to the flint variety Waushakum alone.

CORN VS. FERTILIZER.

For this presentation we have the record of the same plats planted with corn during four years, and the yield corrected to a full stand of four plants to a hill, as recorded in past reports. The corrected yield of ear corn, from the tenth acre plats, for the various years, was as below:—

Plats.	Corrected yield. lbs. of ear corn. 1882. lbs.	1883. lbs.	1884. lbs.	1885. lbs.	Average for four years. lbs.
A. 1.	418½	483	471	507	470
A. 2.	395	488	480	478	460
A. 3.	421	493	486	459	465
A. 4.	461½	538	544	472	504
A 5.	458	530	553	467	502
A. 6.	324¾	443	463	456	422
A. 7.	406	443	523	464	459
A. 8.	386½	441	546	462	459
A. 9.	393	422	511	458	446
A. 10.	349	405	526	477	439
Total, 1 acre	4013½	4686	5103	4700	4626

The amount of phosphate used per acre during these years was:

Plats.	1882. lbs.	1883. lbs.	1884. lbs.	1885. lbs.
A. 1.	0	0	200	400
A. 2.	200	0	200	400
A. 3.	400	0	200	400
A. 4.	800	0	200	400
A. 5.	1600	0	200	400
A. 6.	200	0	200	400
A. 7.	400	0	200	400
A. 8.	800	0	200	400
A. 9.	1600	0	200	400
A. 10.	0	0	200	400

Arranging the averages according to fertilizer applied during the four years, we have for a summary in bushels of 80 lbs. ear corn, per acre:—

	Total phos. per acre. 4 years. Lbs.	Av. yield. 4 years. Bush. per acre.
A. 1 and A. 10	800	56.8
A. 2 and A. 6	1200	55.1
A. 3 and A. 7	1600	57.7
A. 4 and A. 8	2400	60.2
A. 5 and A. 9	3600	59.2

The figures of phosphate application per plat, and yield per acre, for the several years are as below:—

	1882		1883		1884		1885	
	Phos. used. Lbs. ℘ acre.	Yield. Bus. ℘ acre.	Phos. used. Lbs. ℘ acre.	Yield. Bus. ℘ acre.	Phos. used. Lbs. ℘ acre.	Yield. Bus. ℘ acre.	Phos. used. Lbs. ℘ acre.	Yield. Bus. ℘ acre.
A. 1 and A. 10	0	48.0	0	55.5	200	62.3	400	61.5
A. 2 and A. 6	200	45.0	0	58.2	200	58.9	400	58.4
A. 3 and A. 7	400	51.7	0	58.5	200	63.0	400	57.7
A. 4 and A. 8	800	53.0	0	61.2	200	68.1	400	58.4
A. 5 and H. 9	1600	53.2	0	59.5	200	66.5	400	57.8
Average		50.2		58.6		63.8		58.8

Although the corn was grown on the same land, we cannot say that there was any diminution of crop in the successive years, and we may well believe that the fertilizer has availed to maintain productiveness. When, however, we examine into the effect of various applications, we get no clear evidence of any relationship between the amount applied and the succeeding crop of the year, or the average of the crops of the various years.

In D. 3 and D. 4, we had Waushakum corn, planted and treated in like manner as the above, except it received phosphate at the rate of one ton per acre. The yield was

	Phosphate per plat, lbs.	No. of plants.	Yield per plat. Merchantable ear corn.		Unmerch. ear corn.	
			No. of ears.	lbs.	No. of ears.	lbs.
D. 3	100	636	780	246¾	147	13
D. 4	100	635	771	305½	170	15
D. 8	100	641	740	271¼	174	16½
D. 9	200	642	740	265¾	136	13¼

Calculating to bushels per acre, and ears per acre, we have:—

	Phos. ℔ acre lbs.	Yield per acre. Merch. ear corn bus. ℔ acre.	Unsound. bus. ℔ acre.	No of ears ℔ acre. Sound.	Unsound
Av. of A. 1 to 10, 20 plats	400	57.6	2.1	12,604	1440
Largest yield of above, A. 1 upper	400	65.1	1.4	14,340	1180
D. 3...........................	2000	61.7	3.2	15,600	2940
D. 4...........................	2000	76.4	3.7	15,420	3400
D. 8...........................	2000	67.8	4.1	14,800	3480
D. 9...........................	4000	66.4	3.3	14,800	2720

Another series of plats, upon land considered by us as inferior in natural quality to that constituting the plats above, fertilized with Acme phosphate, where fertilizer was used, gave crop as below:—

	Phos. ℔ acre. lbs.	Yield per acre. Merch. ear corn. bus. ℔ a.	Unsound. bus. ℔ a.	No. of ears per acre. Sound.	Unsound
G. 7	0	52.3	2.9	11,820	1900
G. 9	0	56.0	2.2	12,760	1580
G. 11	0	51.5	3.0	11,160	2200
G. 6	500	66.4	2.3	13,700	1940
G. 8	500	70.6	2.6	14,280	1860
G. 10	1000	67.4	2.9	13,660	2220

Examining these two series of experiments in detail D plats being duplicates, so far as we could determine in advance, as also the G plats with each other, we find the following variations in crop under like conditions of fertilization between the various plats:—

No fertilizer, ... 51 and 56 bushels per acre, Difference 5 bushels.
500 lbs. fertilizer.... 66 and 70 " Difference 4 "
2000 lbs. fertilizer.... 61 and 76 " Difference 15 "

The average yield of the variously treated plats are, per acre:—

No. of plats.	Treatment.	Average yields.	Largest yields.
3	No fertilizer	53.3 bus.	56.0 bus.
10	400 lbs. fertilizer	57.6 bus.	65.1 bus.
2	500 lbs. fertilizer	68.5 bus.	70.6 bus.
1	1000 lbs. fertilizer	67.4 bus.	67.4 bus.
3	2000 lbs. fertilizer	68.6 bus.	76.4 bus.
1	4000 lbs. fertilizer	66.4 bus.	66.4 bus.

These plats, as mentioned above, are not strictly comparable, there being two series; in addition, the same number of trials were not made under each treatment, hence the average figures have not equal values. The general conclusion, however, must be that the fertilizer showed little effect, and the figures indicate the best results from moderate applications.

LARGE AND SMALL SEED.

Kernels of Waushakum corn were divided into two selections, the one comprising the largest, the other the smallest seed. The planting was in hills 42 x 44 inches, four plants to a hill, and 400 lbs. phosphate per acre was applied.

The figures of the crop were:—

		Yield per plat.			
	No. of plants.	No. of good ears.	No. of poor ears.	Wt. of good ears, lbs.	Wt. of poor ears, lbs.
D. 12 Large seed	637	700	77	271.5	8.0
D. 13 Small seed	637	724	98	277.5	8.2
D. 14 Large seed	623	726	85	282.5	9.0
D. 15 Small seed	632	715	97	266.2	8.7

We do not find much difference between the crop from the two kinds of seed. The average for the two plats planted with like seed, per acre, is as below, corrected to like number of plants:—

	No. of good ears.	No. of poor ears.	Bus. of good ears.	Bus. of poor ears.	Av.wt. ears,ozs
D. 12 and 14 Large seed	14,360	1630	69.7	2.1	6.21
D. 13 and 15 Small seed	14.390	1950	67.9	2.1	6.04

The explanation of these slight differences must be sought for in the experiments of Francis Galton, recorded in a lecture before the Royal Institution of England, Feb. 9, 1877. In this trial, seed separated into large and small was distributed to many places in England, and the resultant crop returned to him for study. He found that the offspring did not tend to resemble their parent seed in size, but to be smaller than the parents ; if the parents were large, to be larger than the parents, if the parents were small. The experiments showed further that the mean filial regression towards mediocrity was directly proportional to the parental deviation from it. (It is unfortunate in our case that the seed planted was not weighed.)

The explanation offered by Mr. Galton is ingenious and appears trustworthy, and is based upon additional data collected from anthropological enquiries, and relating to the heights of children and their parents. " The child inherits partly from his parents, partly from his ancestry. Speaking generally, the further his genealogy goes back, the more numerous and varied will his ancestry become, until they cease to differ from any equally numerous sample taken at haphazard from the race at large. Their mean stature will then be the same as that of the race." * * * "The average regression of the offspring to a constant fraction of their respective mid-parental deviations, which was first observed in the diameter of seeds, and then confirmed by observations on human stature, is now shown to be a perfectly reasonable law which might have been deductively foreseen." He then goes on to explain that " the heritage derived on an average from the mid-parental deviate, independently of what it may imply, or of what may be known concerning the previous ancestry, is only ½. Consequently, that similarly derived from a single parent is only ¼, and that from a single grandparent is only $\frac{1}{16}$." These figures are of great interest to the breeder both of seeds and domestic animals, as they prove that a different set of figures must be used in calculating the predominance of heredity than those at present used.

THICKNESS OF PLANTING.

In six plats, E. 6 to E. 11 inclusive, Waushakum corn was planted in different thickness. The phosphate used was 400 lbs. per acre. In all but E. 11, the hills were 42x44 inches apart, in E. 11 the hills were 42x88 inches. The yield and further particulars are given in tabular form.

	Yield per plat.				
	No. of plants.	No. of Good.	ears. Poor.	Wt. of Good.	ears . lbs. Poor.
E. 6. 1 plant to a hill	162	565	180	188.0	20.0
E. 7. 2 plants to a hill	321	679	265	243.7	24.2
E. 8. 3 plants to a hill	426	655	186	257,0	18.5
E. 9. 4 plants to a hill	641	763	116	294.7	12.2
E. 10. 5 plants to a hill	803	835	153	300.7	14.0
E. 11. 10 plants to a hill	439	432	99	142.2	9.7

	No. of ears per plant.		Average wt. of good ears: ozs.	Wt. of ears per plant: lbs.		Yield per acre good ears: bus.
	Good.	Poor.		Good.	Poor.	
E. 6. 1 plant per hill	3 5	1.1	5.32	1.16	.12	47.0
E. 7. 2 plants "	2.1	.8	5.43	.76	.07	60.9
E. 8. 3 " "	1.5	.4	6.28	.60	.04	64.2
E. 9. 4 " "	1.2	.2	6.18	.46	.02	73.7
E. 10. 5 " "	1.0	.2	5.76	.37	.02	75.2
E. 11. 10 " "	1.0	.2	5.18	.32	.02	35.5

We hence infer that four or five kernels to a hill is the best number to use in this locality in this season, and at this distance of the hills. With more distant planting the number of ears to a plant is increased, but their average size is diminished ; the weight of ears produced per plant is also increased by thin planting, but the increase in crop did not compensate for the fewer number of plants. The group planting, or what the farmers' boys would call 'King hill' system, scarcely encourages continuance of such trials.

OATS.

The importance of variety to the farmer finds illustration in our this year's experiments with oats. The plats one-twentieth of an acre, in 1882 sod; in 1883, 400 lbs. fertilizer per acre and forage crops; in 1884, 400 lbs. fertilizer per acre and potatoes; in 1885, 400 lbs. fertilizer per acre, and oats in two varieties, the Welcome as representing a common oat and the White Russian as representative of a side head oat. The yield was as below:

Plat.	Variety.	Yield per plat. Straw. lbs.	Yield per plat. Grain. lbs.	Calculated yield per acre. Straw. tons.	Calculated yield per acre. Grain. bus.
E. 16.	White Russian	160½	132	1 605	82.5
E. 18.	do	187½	131½	1.875	82.2
E. 17.	Welcome	163	87½	1.630	54.7
E. 19.	do	119	79½	1.190	49.7

This, it is true, is but a local result. It is within the limits of possibility that in another region the Welcome might have been superior, yet the trial may stand forth prominently as a test that may be read thus:—some one variety of seed may find better adaptation on a farm than the seed in use, and the cheapest way to secure increase in crop without extra expense in the growing may often be from the change of seed from a less prolific variety to a greater.

The Welcome oat showed a weak straw, and before the harvest, was flat upon the ground. The White Russian oat possessed a stiff straw, and stood erect until close upon harvest, when it was partially bent over by a storm. The Welcome oat was harvested on July 31, the White Russian ten days later, or on August 10. It was quite evident that the White Russian, although exposed for a longer period to the vicissitudes of the weather on account of its lateness of maturing, yet could have borne a heavier crop without becoming procumbent; on the other hand the Welcome oat bore a heavier crop than its straw could support, and a larger proportion of its grain was probably saved under the careful harvesting of a plat, than under the ordinary process of field work. These circumstances lead us to believe that the practical prolificacy of the two kinds are different through the inherent qualities of the plant, and that hence their reactions to fertilizer may be different. We may express this idea in its practical relations by the following proposition: If the maximum yield of an oat plant is 50 bus. per acre, then it is not essential to fertilize beyond this 50 bushel limit; if the maximum yield of an oat plant is 80 bushels, then we should fertilize beyond the 50 bushel limit, and up to the 80 bushel. This relation between fertilizer used and the plant may again find expression in the statement that on poor soil and under unfavorable conditions a radical difference in prolificacy between two varieties may become obscured, while upon rich soil and extra favorable conditions, it may become widely differentiated. We may follow with the statement of a probable truth, that the farmer who uses improved varieties of seed can afford to use a larger amount of fertilizer than he who grows crops from unselected and carelessly secured seed.

The nomenclature of farm seed is in a state of chaos. There seems to be no authority which shall settle the question of variety, and hence the name under which a variety is sold is a matter of accident, or ignorance. For us to recommend the White Russian or to condemn the Welcome oat, is simply to express the facts of this year with reference to seed planted under these respective names. If we should base our opinion of values upon this year's trials upon our soil and recommend the White Russian for general culture, the farmer who desired to follow this decision into practice could not be assured that in purchasing his seed he was obtaining under the name the variety or the strain which with us yielded the good crop. In our test of varieties this year we find the White Russian distributed by seedsmen under several names, as also the Welcome oat. Although our study of varieties has been carried forward under unusually favorable opportunities, yet at date we are unable to give descriptions which shall enable varieties to be safely recognized by the reader, and until this be done, variety tests as to value for crops can have but little general significance. Hence the great, almost paramount, importance that an experiment station should secure a nomenclature whereby its recommendation of a variety or of a strain can become effective in its influence upon the general public.

The principal points which render one variety of an oat more desirable than another are strength of straw, whereby a large crop can be borne without partial destruction through lodging; prolificacy in grain, in number, size and weight; the property of not shedding the grain during the process of harvesting; resistance to rusts, mildews, etc., etc. This year, with us, the one-sided oats surpass the common form in all these particulars, but our experience is not as yet sufficient for us to generalize as to what will occur in a different season or on a different soil. The safest recommendation that we can offer, and one which in the end will bring satisfaction to all parties, is that farmers should annually purchase in small quantities different varieties of seed from those in their own use, and by growing on a small scale should determine for themselves whether gain, perhaps large gain, would not accrue to them from change of seed to a variety better adapted to their farm and their farming. This course would be little expensive, the gain might be great.

POTATO TRIALS.

The year 1885 was a favorable one for the growing of the potato, although marked by the presence of abundant rot. We rarely have a season where duplicate trials would be expected to come closer in their results, as there was no drought, and no excess of water during the tuber-growing season.

We present our figures under the various headings which appear below :—

Duplicate Plats.

The crops of B. 5 upper and B. 6 lower, in 1884, were nearly identical; 243 lbs. good, and 7 lbs. soft ear corn ; 243 lbs. good, and 5 lbs. soft ear corn. B. 5 lower, in 1884 yielded 281 lbs. good and 2 lbs. soft ear corn, while B. 6 upper yielded 233 lbs. good and 7 lbs. soft ear corn. We might hence assume provisionally that B. 5 upper and B 6 lower, were of equal fertility. These plats were planted in 1885 with White Star potatoes, single eyes, the hills one foot, the drills 44 inches apart, and 20 lbs. super-phosphate per plat. The yields were :—

	Merchantable.		Small.		Rotten.		Total.		No. of hills.
	lbs.	oz;	lbs.	oz.	lbs.	oz.	lbs.	oz.	
B. 5 upper	162	8	12	14	341	0	515	12	560
B. 6 lower	154	8	9	8	290	0	454	0	565
Difference	8	0	2	12	51	0	61	12	
B. 5 lower	174	12	10	4	351	0	536	0	569
B. 6 upper	117	4	7	8	432	4	557	0	562
Difference	57	8	2	12	81	4	21	0	

In B. 12 and B. 13, we again have what may be considered duplicate plats. In 1884 the upper portion of each yielded a total of 547 lbs. of White Star potatoes. B. 12, lower, 477 lbs. and B. 13 lower 510 lbs. The planting and fertilizer as in the plats reported above. The yields in 1885

	Merchantable		Small.		Rotten.		Total.		No. of
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs;	oz.	hills.
B. 12 upper	207	4	12	4	430	4	649	12	561
B. 13 upper	135	8	11	12	393	12	541	0	568
Difference	71	12	23	8	36	8	108	12	
B. 12 lower	340	4	25	8	397	8	763	4	566
B. 13 lower	216	4	16	0	717	4	949	8	571
Difference	124	0	9	8	319	12	186	4	

We have in B. 5 upper and B. 6 lower, duplicates, a difference of 20 bush. per acre; in B. 12 upper and B. 13 upper, duplicates, a difference of 36 bus. per acre in total yield, In the less near duplicates, or the plats in which the yield varied in 1884, the like differences are 7 bushels and 36 bushels in total crop.

The lesson to be derived is that there is a great uncertainty in ascribing differences in crop to the preceding treatment, and that differences of 20 or 30 bushels per acre should not be considered decisive as for or against the applied fertilizer, or changes in treatment.

As having additional bearing upon the subject of duplicates, we put in D. 1, D. 2, D. 5 and D. 6 as duplicates, White Star potatoes, single eyes, hills 12 inches apart, drills 44 inches. On these plats of one-twentieth of an acre was put 100 lbs. of phosphate, or at the rate of one ton to the acre.

	Merchantable.		Small.		Rotten.		Total.		No. of
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs,	oz.	hills.
D. 1	210	4	16	4	187	4	413	12	576
D. 2	245	0	20	8	174	4	419	12	575
D. 5	224	12	13	12	249	4	487	12	571
D. 6	140	12	11	8	279	12	432	0	562

The extreme variation in total crop, under this exceptional use of fertilizer, is 24.6 bushels per acre, and this but enforces the conclusions already gained.

METHOD OF CUTTING.

The experiment was to ascertain whether there is any efficacy in the direction in which the seed is cut. The seed used in the one series was cut to single eye, the slope of the cut toward the stem end, whereby the pith rays are not greatly shortened; this kind of cutting is called the ordinary cut. The second series had the seed cut in the reversed direction, or toward the "seed" end, whereby the pith rays are greatly shortened; this cut we call the reverse cut. The trial comprised eight plats of one-twentieth of an acre each. The variety of potato the White Star, one eye to a hill, the hills one foot apart in drills 44 inches apart, and 20 lbs. super-phosphate applied, or 400 lbs. per acre.

	Merchantable.		Small Potatoes.		Rotten.		Total.		No. of hills.
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	
					Ordinary Cuts.				
B. 2, Upper	208	8	13	4	314	8	536	4	560
B. 3, Upper	206	12	13	0	304	0	523	12	560
B. 2, Lower	158	0	12	0	193	4	363	4	560
B. 3, Lower	163	12	17	0	249	8	430	4	566
Mean	185	4	13	13	265	5	436	6	561
					Reversed Cuts.				
B. 1, Upper	170	12	13	8	343	0	527	4	564
B. 4, Upper	124	4	10	4	262	4	396	12	538
B. 1, Lower	144	0	19	12	264	6	428	2	570
B. 4, Lower	156	12	14	4	305	8	476	8	542
Mean	148	15	14	7	293	12	457	2	553

Interpreting these figures in connection with our report upon the same subject in 1884, we cannot see evidence that the differences are sufficient to warrant a conclusion for or against either system of cutting. It is noticeable however that there is a slight difference against the reversed cut in the mean, in all the columns. The hills planted were 594 to each plat. In the case of the ordinary cuts 94.4 per cent. vegetated and gave crop, in the case of the reversed cuts 93.1 per cent.

SIZE OF THE SEED.

Plat B. 16 was planted in two sections; in the upper single eyes in large pieces used; in the lower, single eyes in small pieces. The hills one foot apart, the drills 44 inches. Twenty pounds of phosphate was used on each half plat, or 400 lbs. per acre.

	Merchantable.		Small.		Rotten.		Total.		No. of hills.
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	
B. 16, Upper	162	8	33	4	305	0	500	12	570
B. 16, Lower	63	12	25	8	100	4	189	8	510

These results are so entirely favorable to the large seed, that we cannot allow them to pass without accepting their meaning, especially under conditions of field culture with but fairly fertile land. Other plats, however, may be cited in evidence.

	Merchantable.		Small.		Rotten.		Total.	
	lbs.	oz.	lbs,	oz.	lbs.	oz.	lbs.	oz.
			⅓ Potatoes as seed.					
B. 7, Upper	202	0	19	12	702	4	924	0
B. 7, Lower	258	12	36	12	336	12	632	4
B. 8, Upper	194	4	14	4	713	8	922	0
B. 8, Lower	218	4	25	0	470	8	713	12
			¼ Potatoes as seed.					
B. 12, Lower	340	4	25	8	397	8	763	4
B. 13, Lower	216	4	16	0	717	4	949	8
B. 14, Upper	136	0	9	4	711	8	856	12
B. 15, Upper	235	8	28	12	403	12	668	0

The summary of the various plats, give:—

	Merchantable.		Small.		Rotten.		Total.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
Av. of 12 plats, single eyes	156	10	11	4	340	9	508	7
Largest single plat, B. 12, upper	207	4	12	4	430	4	649	12
Av, of 4 plats, ⅓ potatoes,	218	5	23	15	555	12	798	0
Av. of 4 plats, ¼ do	232	0	19	14	557	8	809	6

The yields are favorable to good sized seed pieces, but the quality, in our judgment, is in favor of the single eyes, although why it should be so is largely a matter of conjecture.

PORTION USED AS SEED.

Plats B. 7 and B. 8, were planted with White Star potatoes, cut into three pieces as lower, middle and upper thirds, three rows of each kind, the hills one foot apart, the drills 44 inches. Twenty pounds of phosphate per plat. The yields were:—

	Merchantable.		Small.		Rotten.		Total.		No. of hills,
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	
Lower third of potato.									
B. 7, Upper	79	0	7	12	219	0	305	12	194
B. 7, Lower	90	4	15	8	111	8	217	4	192
B. 8, Upper	78	0	4	12	225	4	308	0	196
B. 8, Lower	82	8	8	12	145	0	236	4	194
Mean	82	7	9	3	175	3	266	13	194
Upper third of potato.									
B. 7, Upper	71	12	6	8	245	4	323	8	195
B. 7, Lower	84	0	10	4	110	12	205	0	194
B. 8, Upper	56	4	3	12	252	0	312	0	197
B. 8. Lower	67	4	7	8	159	4	234	0	192
Mean	69	13	7	0	191	13	268	10	194
Top third of potato.									
B. 7. Upper	51	4	5	8	238	0	294	12	195
B. 7. Lower	84	8	11	0	114	8	210	0	195
B. 8, Upper	60	0	5	12	236	4	302	0	196
B. 8, Lower	68	8	8	12	166	4	243	8	192
Mean	66	1	7	12	188	12	262	9	194

This trial certainly does not indicate that the one portion is superior to another in its influence upon crop. In the presence of so much rot, and the uneven distribution of the rot, the figures of total yield are those which must be consulted in preference to those of merchantable yield. This experiment must have frequent repetition, before any results can be deemed decisive.

Two plats, E. 2 and E. 20, were planted with single eyes in the order as taken from the potato. The crop of the three-thirds, throwing the odd eyes in the central piece, were as below, 30 potatoes used on E. 2, and 29 on E. 20.

	But third.		Central third.		Tip third.	
	Plat E. 2.	E. 20.	Plat E. 2.	E. 20.	Plat E. 2.	E. 20
No. of eyes	177	177	204	211	177	177
Total yield, lbs.	119.6	113.6	181.2	180.4	110.8	124
Av. per eye, ozs.	10.8	10.3	14.2	13.7	10.0	11.2

In this trial the central eyes have yielded the best. Arranging in tabular form our 1883 and 1884 trials along with E. 2 and E. 20, we have five trials.

			Yield calculated to the 100 eyes; lbs.		
		No. of eyes	But third	Central third	Tip third
C. 5,	1883	576	87.3	156.4	142.0
D. 7,	1884	528	92.2	119.9	96.5
D. 10,	1884	549	65.9	77.5	53.8
E. 2,	1885	558	21.4	32.4	19.5
E. 20,	1885	565	20.1	31.9	21.9
Mean			57.4	83.6	66.7

Close Planting and Thinning.

Plats B. 9 and B. 10 were planted with White Star potatoes, single eyes, the hills one foot apart, and the drills 22 inches. Upon two sub-plats the hills were thinned to one stalk, upon two the stalks were left to grow. Twenty pounds of phosphate were used per half plat.

	Merchantable. lbs.	oz.	Small. lbs.	oz.	Rotten. lbs.	oz.	Total. lbs.	oz.	No. of hills.
B. 9, Upper, thinned	192	4	25	0	621	4	838	8	1160
B. 10, Upper, not thinned	221	8	22	0	657	0	900	8	1164
B. 9, Lower, not thinned	321	4	35	0	447	8	803	12	1123
B. 10, Lower, thinned	216	8	45	4	388	8	650	4	1015

The mean results are:—

	Merchantable. lbs.	oz.	Small. lbs.	oz.	Rotten. lbs.	oz.	Total. lbs.	oz.	No. of hills.
Thinned plats	204	6	35	2	504	14	744	6	1087
Not thinned plats	271	6	28	8	552	4	852	2	1143
Difference in favor of not thinned,	67	0					107	12	

These results were entirely unexpected, as in the 1884 trials the difference was in favor of the thinned plat 253 lbs. 8 oz. merchantable, the total yield being

	Merchantable.	Total.
D. 5. Thinned	830.5 lbs.	920.7 lbs.
D. 8. Not thinned	577.0 "	676.5 "

These contradictions are however to be expected, so long as we know so little of the varied factors which enter into the complex outcome which we call crop.

The close planting this year, however, as last, seemed favorable. Comparing the yields of the tenth acres close planted, with near plats, we have:—

	Merchantable. lbs.	oz.	Small. lbs.	oz.	Rotten. lbs.	oz.	Total. lbs.	oz.
B. 5 Ordinary distance	337	4	22	8	692	0	1051	12
B. 6 " "	271	12	17	0	722	4	1011	0
B. 9 Double thick	513	8	60	0	1068	12	1642	4
B. 10 " "	438	0	67	4	1045	8	1550	12

It seems quite possible that the effect of neatness or distance of planting will vary according to the condition of the land. On our land, the mean of the plats give for the two plantings:—

		Plants 12 x 44 in.	Plants 12 x 22 in.
Per acre.	Merchantable	50.7 bus.	79.3 bus.
	Small	3.3 "	10.6 "
	Rotten	117.8 "	167.9 "
	Total	171.8 "	257.8 "

Plats D. 16, D. 17, D. 18 and D. 19 were planted with White Star potatoes, single eyes, 400 lbs. phosphate per acre. D. 16 and D. 18 as duplicates, the seed one foot apart in 44 inch drills. D. 17 and 19 as duplicates, the seed two feet apart in 44 inch drills.

	Merchantable		Small.		Rotten.		Total.		No. of hills.
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	
D. 16. Seed 1 foot apart	133	0	15	4	165	12	314	0	572
D. 18. "	124	0	7	4	278	8	411	0	559
D. 17. Seed 2 feet apart......	94	0	6	0	210	8	310	8	289
D. 19. "	69	8	6	0	125	12	201	4	282

D. 16 yielded 8. 8 ozs. total per hill, and D. 18 yielded 11. 8 ozs; D. 17 yielded 17.2 ozs. and D. 19 yielded 11.4 ozs. The average for the two plantings being 10.3 ozs. per hill, the plants one foot apart, and 14.3 per hill, the plants being two feet apart. The best plat of our series, single eyes one foot apart, and duplicate in all conditions under control with these, yielded 18.5 ozs. per hill; one of the plats where the potatoes were planted 12x22 in. yielded 12.3 ozs. per hill. We hence see that our results of trial have no special significance.

POTATO ROT.

The rot has been quite severe with us this year. The average rot in thirty-four plats of one twentieth of an acre each was 65 per cent. of the total crop, by weight, the least being 52 per cent. the greatest bring 83 per cent. The variety the White Star.

Plats.

2	had	52 per cent.	6	had	66 per cent.
3	"	53 "	1	"	70 "
1	"	55 "	1	"	72 "
2	"	58 "	1	"	73 "
1	"	59 "	1	"	74 "
2	"	60 "	1	"	75 "
1	"	61 "	1	"	76 "
2	"	62 "	3	"	77 "
2	"	64 "	1	"	81 "
1	"	65 "	1	"	83 "

In the five plats, D. 1, 2, 5 and 6, treated with a ton of fertilizer per acre, and D. 10, with two tons, the per centage of rot was:—

D. 1, Per cent. of rot	45
D. 2 "	40
D. 5 "	51
D. 6 "	64
D. 10 "	55

By this we may infer that the rot is neither caused nor intensified by the fertilizer.

FERTILIZER ON POTATOES.

Under the same amount of fertilizer, viz. 400 lbs. per acre, and the conditions in all respects alike, so far as under our control, there was much variation which can be sought to be explained by the condition of the land as regards fertility, but unfortunately for this easy solution, the testing of the land by previous crops does not show the relation between the size of crop for the two years that would be so comforting to the theorist. We present the average and extreme yields from twelve plats upon which 400 lbs. phosphate per acre was used.

	Merchantable.		Small.		Rotten.		Total.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
Average of 12 plats............	156	10	11	4	340	9	508	7
Greatest yield..................	207	4	12	4	430	4	649	12
Least yield	158	0	12	0	193	4	363	4
Difference	49	4	0	4	237	0	286	8

This difference of 286½ lbs. of total yield is equal to 95½ bus. per acre; and the difference of 49¼ lbs. merchantable yield is equal to 16.4 bus. per acre; sufficient indeed to justify the careless experimenter, in his own opinion at least, to pronounce for or against two different treatments, or to give a certificate certifying to the superiority of one fertilizer over another, had such been under trial.

In a trial to watch the effect of excessive fertilizer upon the potato crop, the following was obtained from four plats, with one ton phosphate per acre:—

	Merchantable.		Small.		Rotten.		Total.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
Average of 4 plats	205	3	15	8	222	10	443	5
Greatest yield	224	12	13	12	249	4	487	12
Least yield	210	4	16	4	187	4	413	12
Difference	14	8	2	8	62	0	74	0

In D. 10, where fertilizer at the rate of two tons per acre was applied, the yield was

Merchantable	119 lbs.	0 oz.
Small	15 "	12 "
Rotten	169 "	0 "
Total	303	12

The most heavily fertilized plat, it is thus seen, yielded less than the poorest of the moderately fertilized plats.

We may infer from these carefully guarded facts of trial, that mere difference in yield under different applications of fertilizer *may* have not the slightest significance as testifying to the value of the fertilizer used, and that the logic of the crops harvested from adjoining plats is sufficient to throw doubts upon conclusions gained from the mere fact of crop alone, without attention, and most careful attention too, being paid to all other conditions which may have availed.

We may also infer that mere quantity of fertilizer is not potent to secure large crop, and also that a sufficient application *may* in most cases be of as much apparent benefit as a larger application.

The following trial of the Acme fertilizer, in the manner common to experimenters, may serve a purpose in its reporting. The crop White Star potatoes, single eyes, hills one foot apart, drills 44 inches.

	Merchantable.		Small.		Rotten.		Total.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
G. 2, 500 lbs. Acme fertilizer per a.	194	0	7	12	459	4	660	0
G. 3, no fertilizer	178	0	9	12	353	0	540	12
G. 4, 500 lbs. Acme fertilizer per a.	173	12	6	8	509	8	689	12
G. 5, no fertilizer	172	0	10	8	273	0	455	8
G. 12, 1000 lbs. Acme fertilizer per a.	91	8	4	12	364	8	460	12
G. 13, no fertilizer	75	0	4	14	279	4	359	2

The average of the two 'no fertilizer' plats, G. 3 and 5, is 166 bus. per acre; of the two '500 lbs. fertilizer' plats, G. 2 and 4, is 225 bushels, a showing "by the figures" of 59 bushels of total crop to be ascribed to the 500 lbs. fertilizer used. Where double the fertilizer was used, on G. 12, the crop was 153 bushels per acre, and the 'no fertilizer' plat adjoining, G. 13, yielded 120 bushels, a showing by the figures of 33 bushels of total crop to be ascribed to the 1000 lbs. of fertilizer used. The logic of the figures involve a contradiction. One trial says each 100 lbs. of fertilizer used gave increase of about six bushels; another trial says each 100 lbs. of fertilizer used gave increase of about three bushels. We hence have the equation as 100: 100:: 3: 6 or 1= ½, a manifest error, and whose only service is to show to us that our figures in their nature do not admit of such interpretation as this.

These figures do show, however, that the fertilizer was of advantage, *because* in all the cases there was an increase of crop on the fertilized as against the unfertilized adjoining plat. Plats G. 2 and G. 4 may be considered duplicates, and their variation in yield is about 10 bushels per acre. G. 3 and G. 5 may be equally as well considered duplicates, and their variation is about 28 bushels. We cannot hence be certain but that as great a difference might exist between our comparison plats, even without the different treatments.

The impossibility of giving figures which shall correctly and definitely express the advantage accruing from the fertilizer in this case may be further appreciated by considering plats G. 3 and G. 5 in their relations to G. 4. It will be borne in mind that G. 4 is a fertilized plat, while G. 3 and G. 5 are its left and right hand neighboring plats without fertilizer. If the yield of the fertilized plat, 230 bushels per acre, be compared with the yield of the left hand unfertilized plat, 180 bus. per acre, the apparent gain is 50 bushels; if the comparison be with the right hand unfertilized plat, 152 bus. per a., the apparent gain is 78 bushels. Therefore our answer may be equally well 50 or 78 bushels, according to our desire, hence there can be no exactitude to our figures, and we can express the value of the fertilizer application but in terms of greater or less and not numerically.

FERTILIZERS.

The influence of fertilizers upon crops can be better studied in the field than upon plats, as the larger areas tend to equalize conditions, and variation in one direction to become balanced by variation in another. Yet even in large areas we note that the crop is not always proportionate to the fertilizer applied, and it is certainly improper to assume that there is less fertility in the more highly manured portion than in the less, because the crop is less. The Station field of eleven acres of Clawson wheat was planted in three portions, and the crop harvested was as below.

2¾ acres, 300 lbs. land plaster per a.	crop 29.81 bush.
4¾ acres, 295 lbs. superphosphate per a.	crop 45.47 bush.
3½ acres, 400 lbs. "	crop 42.57 bush.

The inference is justifiable that the increase of crop came through the action of the applied fertilizer, but it would be erroneous to infer that less fertilizer was more efficacious than a greater quantity. A slight difference in the amount of winter killing would account for all the variation noted between the two fertilized fields.

One oat field, White Russians drilled in on corn stubble, with 200 lbs. superphosphate per acre, received four different seedings.

½ acre, 3 pecks seed per a.	crop 54 bus. per a.
½ " 4 " " "	crop 56 " "
½ " 8 " " "	crop 66 " "
½ " 10 " " "	crop 66 " "

A two-acre portion, with Welcome oats, 6 pecks per acre, the same amount of fertilizer, yielded 44½ bushels.

We, in this last instance, find that the differences in the crop do not follow the amount of fertilizer applied, but seems to have been determined by the amount of seeding, and the variety grown. We have additional illustration in the yield of four duplicate plats of one-twentieth of an acre, 20 lbs. fertilizer having been used on each, and the same amount of seed.

	Yield per acre.	
	Straw.	Grain.
E. 16. White Russian oats	1.605 tons.	82½ bus.
E. 18. do	1.875 tons.	82¼ bus.
E. 17. Welcome oats	1.630 tons.	54¾ bus.
E. 19. do	1.190 tons.	49¾ bus.

Under duplicate conditions, the White Russian oats yielded practically the same grain, but different amounts of straw, on the two plats; the Welcome differed 5 bus. in grain and nearly a quarter of a ton in the straw, while *variety* apparently produced about 30 bushels difference.

If we now compare the crops and fertilizer used in the fields and plats, we have:—

White Russian	200 lbs. fertilizer, in field	66 bushels.
	400 lbs. fertilizer, in plat	82 "
Welcome	200 lbs. fertilizer, in field	44 "
	400 lbs. fertilizer, in plat	52 "

That is, the 200 lbs. increase of fertilizer makes 16 bus. difference in the White Russian, and 8 bus. in the Welcome if our figures are interpreted as they stand.

The logical inference is, and probably true, that fertilizer does not show the same amount of effect upon all crops, but that we must use the best of seed in order to obtain the most profitable results from increased quantities of fertilizer. Expressed in axiomatic form, the more fertilizer used, the better should be the seed used.

In a trial with fertilizer upon the plats, with potatoes, two unfertilized plats averaged 166 bushels total crop per acre, and two plats which received 500 lbs. of phosphate per acre yielded at the rate of 225 bushels per acre. Another series, without fertilizer yielded at the rate of 119.7 bus. total crop, while an adjoining plat which received phosphate at the rate of 1000 lbs. per acre yielded 153.6 bushels. Twelve other plats, which had 400 lbs. per acre of phosphate, yielded for an average 169 bushels. The only conclusion from these trials must be that plat work is too uncertain for very exact conclusions, and the fertilizer question must be solved rather from other data than simply an increase of yield apparently coincided with use of fertilizer, an idea which is further elaborated elsewhere.

In a trial with corn, reported elsewhere in more detail, three plats without fertilizer yielded in bushels of 80 lbs. each of ear corn, an average of 53.2 bushels of good, and 2.7 bushels of soft corn per acre; two plats with 500 lbs. phosphate per acre yielded 61 bushels good, and 4.9 bus. of soft corn; one plat with 1000 lbs. phosphate per acre yielded 67.4 bus. sound corn, and 2.9 bus. of soft. Interpreting our figures as given we may say the first 500 lbs. of phosphate produced 8 bushels increase, and the second 500 lbs. of phosphate produced 6 bushels increase, but such a conclusion would be manifestly erroneous.

Duplicate Germinations.

In order to test the value of a single germination, or in other words the variation in germination between presumably equally good seed, a series of duplicate germinations was made with some Christiana melon seed of known age, and of careful selection. The seed was grown at Framingham, Mass., in 1879, and had been carefully winnowed, and represented the product from about 1200 melons carefully selected as on type, and of superior quality. The test was Sept., 1883, when four years of age. The germinations were duplicates in every respect, the seed occupying the same apparatus, exposed to the same moisture and the same temperature. The first germination in the twenty-three samples of fifty seed each was in all cases on the second day, half had gerimnated in twenty-two of the trials on the third day, and the last seed germinated in from four to eight days. The average germination was 78 per cent., the extremes of the trial were 66 and 86 per cent.

We thus see that in this case, in trials with fifty seed, a variation of twenty per cent. in the expression of single germination results had little meaning. We may assume that a larger number of seeds at a trial are required in order to obtain close duplication. Our results can be calculated, by massing the adjoining seeds, into those with one hundred, two hundred, etc., seed, as below:—

Per cent. germinated in trials of				
I. 100 seed.	II. 200 seed.	III. 300 seed.	IV. 400 seed,	V. 500 seed.
70	76	75	74	73
82	73	74	76	79
73	74	79		
73	79			
66	78			
83				
82				
76				
79				
78				
86				

With 50 seed used, the variation was 20 per cent.; with 100 seed it was 20 per cent.; with 200 seed it was 6 per cent.; with 300 seed it was 5 per cent.; with 400 seed it was 2 per cent.; and with 500 seed it was 6 per cent.

The conclusion is evident, that in germinating single samples of melon seed from two different sources, in numbers of one hundred, we are not justified in pronouncing one of better quality than another, if the variation is not over twenty per cent., and such a difference could have no further meaning than to suggest further trial before decision.

A second trial of the value of duplicates was with seedsmen's seeds, each packet taken from a different bag of the same stock. Danvers Yellow onion seed, growth of 1882, tested 50 seeds at a trial in June, 1883, and fifty-one tests. The average germination was 89 per cent., the extremes 74 and 98 per cent., or 24 per cent. difference.

Massing into groups of 100, 200, etc., of seed, as with the melon, we have :—

Per cent. germination of duplicates of				
I. 100 seed.	II. 200 seed.	III. 300 seed.	IV. 400 seed.	V. 500 seed.
86	89	88	89	89
92	88	90	89	88
87	90	89	88	90
90	89	90	90	88
89	87	89	87	88
90	92	89	89	
87	91	86		
92	89	90		
88	87			
87	86			
97	90			
87	89			
91				
92				
84				
95				
89				
85				
89				
82				
86				
94				
91				
86				
85				

We thus note that with 50 seed, the variation in germination between duplicates is expressed by 24 per cent.; with 100 seed 15 per cent.; with 200 seed by 6 per cent.; with 300 seed by 4 per cent.; with 400 seed by 3 per cent.; with 500 seed by 2 per cent.

The lesson is that in germinating onion seed for comparing two different sources of supply, at least 200 seed should be used, and the differences observed should only be interpreted within the limits of six per cent., etc., for one year old seed, so far as this limited experience indicates.

As a further study into the value of duplicates, the following tables may not be without significance. The number of seed used being in every case 100. The temperature and the moisture being the same for each bracketed group, and that of the office as between the groups.

		Germination trials. Per cent. germinated.						
ONION.	Year of growth.	Dec. 6, 1884. Exact duplicates.		Dec. 20, 1884. Exact duplicates.		Av. of the two trials.		Difference
White Portugal	1882	30	33	35	52	31	43	12
White Globe	1882	14	19	7	15	16	11	5
White Globe	1882	39	39	50	51	39	50	11
Large Red Globe	1882	13	16	15	15	14	15	1
Large Red Globe	1882	34	40	41	42	37	41	4
Large Red Globe	1882	28	32	33	34	30	33	3
Large Red	1883	38	40	87	90	39	88	49
Large Red	1883	0	8	35	40	4	37	33
Large Red	1882	8	11	43	45	9	44	35
Large Red	1882	9	12	51	57	10	54	44
Yellow Danvers	1883	42	42	61	64	42	62	20
Yellow Danvers	1882	21	23	49	53	22	51	29

ONION.	Year of growth.	Germination trials. Per cent. germinated. Dec. 6, 1884. Exact duplicates.		Dec. 20, 1884. Exact duplicates.		Av. of the two trials.		Difference
Yellow Globe Danvers	1883	18	19	62	69	18	65	47
Yellow Globe Danvers	1882	25	33	67	68	29	67	38
Giant Rocco	1881	1	1	7	16	1	11	10
Globe Madeira	1883	8	9	44	58	8	51	43
Globe Madeira	1881	3	6	32	33	4	32	28
Golden Queen	1883	27	31	60	65	29	62	35
Flat Madeira	1883	17	17	45	51	17	48	31
Flat Madeira	1881	6	7	17	22	6	19	13
Brown Teneriffe	1883	0	8	1	4	4	2	2
Brown Teneriffe	1882	3	9	33	35	6	34	28
White Silver Skin	1880	0	1	0	0	1	0	1

Massing the results according to age of seed, we find for the average variation.

	No. of trials.	Average variation between duplicates. 1st trial.	2nd trial.
1 year seed	8	3	6
2 year seed	11	4	4
3 year seed	3	1	5

The average variation between two different trials, 200 seed at a trial, the conditions being not exactly alike in temperature, but deemed at the time as varying but slightly, is as follows:—

	No. of trials.	Average difference.
1 year seed	8	32
2 year seed	11	18
3 year seed	3	17
	Average	22

We thus note that the variation between duplicate trials, with mixed varieties of seed may exceed 17 per cent., and averaged in one case 5 per cent.; with apparent duplicates the variation between the trials may exceed 48 per cent., and in one case averaged over 22 per cent.

Our next trial to report is when the temperatures were absolutely known in three out of five cases, and the other conditions identical. The seed of the crop of 1884, the germinations from Oct., 1884, to Feb., 1885.

	Per cent. germinated. 425 hours. 41°-45.3°	396 hrs. 40.8°-44.6°	400 hrs. 41.5°-43.7°	Temp. of office. Exact duplicates.	
Cabbage.					
Henderson's Selected Jersey Wakefield	99	98	100	95	97
Henderson's Early Summer	100	100	96	97	99
Kohl-Rabi.					
White Vienna	71	66	72	86	89
Kale.					
Siberian	98	98	82	96	97
Lettuce.					
Salamander	89	91	87	34	40
Onion.					
Red Wethersfield	88	84	95	95	97
Red Italian Tripoli	86	67	89	98	98
Ruta Baga.					
Imp. Am. Purple Top	99	100	98	93	95
Turnip.					
Purple Top Strap-leaf	92	97	81	92	95
Purple Top White	85	88	37	87	92

We note here also discrepancies between results as heretofore noted, and which enforce still more the conclusion as to the uncertainty of a conclusion derived from a single trial.

Our next trial is with duplicates under exact conditions, and under different dates at the temperature of the office.

Germinations at Temperature of Office.

	Year of growth	Oct.. 1884. Exact duplicates. Per cent.		Feb. 1885. Exact duplicates. Per cent.		Average of the two trials. Per cent.		Dif. bet'n two trials
Asparagus.								
Conovers Colossal	1883	94	97	90	93	95	91	4
Beet.								
New Dark Egyptian Turnip	1882	74	79	86	89	76	87	11
Early Bassano	1883	73	81	76	84	77	80	3
Ne Plus Ultra	1878	58	69	58	64	63	61	2
Vilmorin's Improved Sugar	1882	58	72	71	78	65	74	9
Brocoli.								
Early White	1882	30	32	21	35	31	28	3
Early Purple	1880	34	51	14	14	42	14	28
Brussels Sprouts.								
Brussels Sprouts	1883	62	68	50	59	65	54	11
Cabbage.								
Little Pixie	1877	0	1	0	0	1	0	1
Early Jersey Wakefield	1883	93	95	83	84	94	83	11
Early Ulm Savoy	1883	91	92	88	90	91	89	2
Carrot.								
Extra Early Forcing	1883	44	53	36	40	48	38	10
Half-long Red-pointed	1883	73	80	75	78	76	76	0
Long Orange	1883	76	80	77	81	78	79	1
Cauliflower								
Early Dwarf Erfurt	1883	88	89	79	81	88	80	8
Early Snowball	1883	77	80	71	79	78	75	3
Celery.								
White Walnut	1882	2	6	38	52	4	45	41
Incomparable Dwarf Crims'n	1882	15	22	28	30	18	29	11
Kohl. Rabi.								
Early White Vienna	1883	66	68	76	84	67	80	13
Leek.								
Fine Large Flag	1883	57	58	62	67	57	64	7
Large Rouen	1883	57	66	53	59	61	56	5
New Large Carentan	1883	42	45	42	53	43	47	4
Melon.								
Fine Valparaiso	1876	84	92	42	56	88	49	39
Sill's Hybrid	1881	86	90	64	68	88	66	22
Melon, Water.								
Early Mountain Sprout	1881	88	96	86	88	92	87	5
Onion.								
The Queen	1884	38	41	34	35	39	34	5
The Queen	1883	70	77	71	84	73	77	4
White Tripoli	1883	59	62	58	64	60	61	1
White Portugal	1883	97	98	96	98	97	97	0
Early Red Flat	1883	66	79	77	79	72	78	6
Yellow Danvers	1883	71	73	82	88	72	85	13
Yellow Danvers	1882	56	72	80	83	64	81	17
Pale Red Bermuda	1883	83	86	94	98	84	96	12
Parsley.								
Fern Leaved	1883	29	35	30	36	32	33	1
Champion Curled	1883	48	64	63	66	56	64	8
Pepper.								
Large Squash	1883	57	58	48	57	51	52	1
New Cranberry	1882	66	73	56	70	69	63	6
Radish.								
French Breakfast	1881	24	27	37	44	25	40	15
Long White Naples	1883	82	84	79	82	83	80	3
Purple Turnip	1883	71	72	79	83	71	81	10

We cannot, after examination of these tables, escape the conclusion that in the ordinary testing of seeds, we can only be satisfied with results that are large. Wherever the germinative per cent. seems small, a repetition of the trial is demanded, in order to secure certainty that either the samples or conditions were right.

Before our germination trials between seed from different sources of supply can be satisfactory, much preliminary work is required in order to ascertain for each species the conditions that will allow of close duplication in our trials, conditions as respects sampling and temperature. If, however, our trials be made with a sufficiently large number of seeds, we may expect to obtain a nearness of duplication in results, in accordance as we increase the number of seeds used, but what this number should be for any given trial seems yet uncertain.

In the accompanying table is given the results of germination trials at the Station, in order to obtain an idea of the influence of age on the germinative property of seeds. From what we have already said, it will be seen that only those figures which are the results of numerous trials with numerous seed are comparable, and that we have reached but little progress towards a conclusion. The seed used is commercial seed, and represents the average quality as sent out by reputable seedsmen.

RESULTS OF GERMINATIONS, 1882 TO 1885.

VEGETABLE.	No. of trials.	No. of varieties.	No. of seed.	Age in years.	Average per cent. germinated
Alkekengi	2	1	200	14	0
Artichoke	3	1	150	1	63
	1	1	20	2	80
	1	1	30	3	57
Asparagus	15	1	450	1	86
	3	2	150	2	65
	2	2	100	3	40
	1	1	50	9	0
Basil	1	1	100	2	22
	1	1	100	8	15
	2	1	200	9	15
Bean (*Phaseolus vulgaris*)	17	13	680	0	92
	6	3	340	1	96
	6	2	240	2	69
	1	1	50	3	98
Bean (*P. multiflorus*)	1	1	20	0	95
Bean (*P. lunatus*)	1	1	25	1	92
Bean (*Dolichos sesquipedalis*)	1	1	50	2	100
	2	1	50	3	100
Beet (Fruits germinated)	2	2	100	0	81
	22	7	1500	1	74
	27	7	2350	2	70
	4	2	400	3	38
	3	2	250	4	69
	1	1	50	5	88
	4	1	400	6	62
	1	1	50	7	34
	4	3	300	9	33
	2	1	200	10	14
	2	1	100	12	40
	2	1	200	13	27
	1	1	50	14	10

	No. of trials.	No. of varieties.	No. of seed.	Age in years.	Average per cent. germinated
	4	2	400	15	18
Boneset	1	1	100	2	1
	2	1	200	3	0
Borage	4	1	400	2	32
	1	1	100	5	58
	2	1	200	6	38
	1	1	47	9	4
Brocoli	5	3	500	1	79
	12	4	1200	2	64
	2	2	200	3	59
	7	3	700	4	35
	2	1	200	5	31
	2	1	200	7	43
	2	1	200	11	3
Broom Corn	4	2	400	2	42
	6	2	300	3	61
Brussels Sprouts	9	2	900	1	66
	2	2	200	2	80
	2	1	200	3	83
	2	1	200	9	0
Burnet	4	1	400	5	20
	1	1	50	8	38
Cabbage	8	4	800	0	91
	72	24	6750	1	85
	70	21	5200	2	75
	40	17	3100	3	59
	4	3	400	4	69
	5	4	500	6	14
	6	2	600	7	9
	1	1	100	8	0
	4	3	400	10	14
	5	3	500	11	0.2
	2	2	200	16	0
	7	4	700	17	0.4
Caraway	4	1	300	1	33
Cardoon	1	1	50	1	74
	2	1	200	2	70
Carrot	2	2	150	0	48
	46	11	4600	1	60
	20	9	200	2	35
	7	3	700	3	22
	3	2	300	4	7
Caterpillars	1	1	50	1	100
Cauliflower	2	1	200	0	97
	44	12	4400	1	86
	14	7	1400	2	85
	15	10	1500	3	62
	9	6	900	4	53
Celeriac	2	1	200	1	27
	1	1	100	2	1
	2	1	200	3	0
	1	1	100	4	0
	2	1	200	5	0
Celery	1	1	100	0	2
	11	5	1100	1	46
	9	3	900	2	23
	1	1	100	3	0
Chard	4	1	400	1	78
	4	2	400	4	54
	2	1	200	5	38
Chervil	2	1	200	1	65
	1	1	100	2	44

	No. of trials.	No. of varieties.	No. of seed.	Age in years.	Average per cent. germinated
	2	1	200	3	64
	1	1	100	17	0
Chicory	3	2	300	1	55
	3	1	300	3	34
	1	1	100	6	35
Collards	1	1	100	1	29
	2	1	200	2	95
Coriander	2	1	300	1	34
Corn, dent	15	18	850	0	92
Corn, flint	5	3	200	0	99
Corn, pop	2	1	200	0	99
Corn, soft	2	1	50	0	100
	2	1	50	1	44
Corn, sweet	15	8	550	0	99
	2	2	100	1	80
Corn Salad	2	1	200	0	90
	2	1	200	1	73
	2	1	100	3	77
	2	1	200	6	32
	2	2	150	7	18
	3	2	300	8	0
	2	1	200	9	0
	1	1	50	10	2
Cotton	5	2	250	1	65
Cress	1	1	100	1	98
	2	2	200	2	89
	1	1	100	3	87
	3	2	300	6	56
	2	1	200	7	51
Cucumber	3	3	300	0	68
	23	9	1122	1	85
	2	2	150	2	57
	4	3	108	3	95
	3	2	100	4	72
	2	1	50	5	60
	1	1	50	13	40
	1	1	50	19	14
Cumin	2	1	100	8	0
Dandelion	2	1	200	1	18
Dill	2	1	200	1	16
	1	1	100	2	2
Egg Plant	8	4	700	1	50
	2	2	100	3	39
	1	1	50	4	46
	1	1	50	6	28
	2	1	200	9	15
Endive	4	1	400	1	20
	10	3	1000	2	45
	6	3	600	3	38
	1	1	100	18	0
	2	1	200	19	0
Fennel, Sweet	4	1	200	1	39
Fenugreek	2	1	200	5	75
Horehound	2	1	200	2	51
Hysop	2	1	200	3	12
Kale	2	1	200	0	97
	3	2	400	1	95
	2	2	200	2	93
	3	1	200	3	65
	1	1	50	4	16
	2	1	200	5	64
	2	1	100	7	58

	No. of trials.	No. of varieties.	No. of seed.	Age in years.	Average per cent. germinated
Kohl Rabi	2	1	200	0	88
	10	4	1000	1	80
	3	2	200	2	76
	1	1	100	3	94
	4	3	400	4	51
	2	2	100	5	44
	2	1	200	17	0
	2	1	200	20	0
Lavender	2	1	200	16	2
Leek	14	4	1400	1	57
	4	2	400	4	15
	4	2	400	7	5
Lettuce	45	20	4500	0	80
	22	12	2200	1	83
	37	17	3694	2	78
	24	13	2400	3	82
	17	9	1700	4	64
	7	3	700	5	48
	8	3	800	6	36
	1	1	100	9	0
Lupin, Blue	1	1	50	1	88
	22	1	100	2	95
Mangold (fruits germinated)	1	1	50	0	82
	11	6	750	1	81
	8	4	700	2	73
	3	2	250	3	72
	2	1	200	4	41
	1	1	50	5	16
	2	1	200	6	15
	3	3	150	7	31
	5	3	450	8	19
Marjoram, Pot	2	1	200	1	14
	2	1	200	6	0
Marjoram, Sweet	2	1	200	1	36
	2	1	100	3	14
	2	1	200	14	0
Melon, Musk	8	3	429	0	86
	26	10	1120	1	88
	6	4	362	2	92
	4	1	200	3	77
	32	7	1492	4	79
	2	2	200	6	90
	5	2	300	7	90
	4	2	200	8	92
	1	1	50	9	36
	1	1	46	10	85
	2	1	100	14	49
Melon, Water	39	10	968	1	58
	19	11	611	2	65
	11	4	377	3	60
	1	1	25	4	80
	1	1	25	6	80
	1	1	100	8	2
	2	1	100	9	20
	4	1	150	11	8
	4	1	150	12	10
Mustard	4	2	400	2	90
	9	2	900	3	92
	3	2	150	4	73
	2	1	200	10	5
	2	1	100	11	4
Nasturtium	2	1	40	2	100

	No. of trials.	No. of varieties.	No. of seed.	Age in years.	Average per cent. germinated.
	1	1	50	6	4
New Zealand Spinage	2	1	50	1	46
Oats	2	1	223	0	97
	1	1	100	2	98
Okra	2	1	100	1	92
	1	1	50	2	90
Onion	12	5	1200	0	77
	196	20	15619	1	80
	93	20	9200	2	56
	21	12	2000	3	31
	7	3	650	4	5
	1	1	100	7	0
Parsley	18	6	1800	1	57
	3	6	300	2	50
	4	1	400	3	8
	5	4	500	4	10
Parsnip	2	2	200	0	13
	7	5	650	1	28
	6	3	386	3	9
	1	1	50	4	0
	2	1	90	6	0
Pea	16	9	812	0	98
	2	1	200	1	86
	66	26	3588	2	84
Peppers	9	9	893	0	93
	16	6	1600	1	65
	14	7	1150	2	58
	11	8	647	3	41
	2	1	200	4	62
	6	3	600	5	19
	1	1	50	6	4
	2	2	150	8	3
	4	2	350	9	10
	5	3	500	10	0.6
	2	1	200	13	0.5
Poppy, Opium	3	1	300	1	23
Pumpkin	1	1	25	0	92
	9	4	219	1	79
Radish	2	2	200	0	71
	100	34	8350	1	71
	36	17	2500	2	57
	16	8	1250	3	49
	6	6	350	4	54
	4	3	350	5	37
	2	1	200	6	12
	1	1	100	7	3
	2	1	200	8	14
	2	1	200	12	0
Rhubarb	3	3	75	4	72
Roquette	3	1	300	2	91
	2	1	200	3	95
Rosemary	1	1	100	6	0
	2	1	200	7	0
Rue	2	1	200	5	6
Ruta Baga	28	2	2800	0	99
	5	2	250	1	97
	83	6	4350	2	93
	15	5	800	3	77
	8	5	600	4	59
	5	4	500	5	54
	4	2	400	6	20
	1	1	50	7	52

	No. of trials.	No. of varieties.	No. of seed.	Age in years.	Average per cent. germinated.
	1	1	100	9	0
	2	1	200	10	1
	1	1	100	11	0
	2	1	200	12	0
Saffron	2	1	100	2	42
Sage	4	1	350	1	63
	2	1	200	2	4
Salsify	1	1	100	0	93
	4	1	400	1	91
	4	1	150	2	73
	4	1	400	3	20
Savory, Summer	6	1	400	1	26
Savory, Winter	2	1	200	5	0
Savoy Cabbage	10	4	1000	1	92
	8	4	800	2	86
	4	1	400	3	86
	1	1	100	5	33
	2	1	200	6	43
	3	2	300	7	23
	2	1	200	8	6
	1	1	100	10	0
	2	1	200	11	0
Scorzonera	1	1	100	2	16
	2	1	200	3	13
	1	1	100	4	58
Sea Kale	1	1	25	2	24
Shallot	2	1	200	2	0
Skirret	2	1	200	3	0
Sorghum	5	2	600	0	88
	3	3	300	1	45
	7	5	432	2	49
	3	3	250	3	65
	2	1	200	4	60
Sorrel	1	1	100	13	0
	2	1	200	19	0.5
Spinage	16	4	1600	0	39
	14	4	1400	1	28
Squash	4	2	150	0	96
	20	8	542	1	73
	16	9	595	2	76
	12	8	417	3	72
	2	1	100	4	63
	1	1	30	6	10
	3	2	67	10	6
	1	1	50	14	0
Sugar Beet (fruits germinated)	2	2	100	1	78
	7	2	550	2	64
	2	1	200	3	15
Sunflower	2	1	100	1	92
Tansy	2	1	200	2	40
Thyme	4	2	400	1	47
	1	1	100	2	25
	2	1	200	3	34
	1	1	100	7	0
	2	1	200	8	3
Tobacco	1	1	100	1	30
	6	3	600	2	42
	5	3	500	3	56
	4	2	400	4	59
	4	3	400	5	66
	4	2	400	6	60
	5	4	500	7	41

	No. of trials.	No. of varieties.	No. of seed.	Age in years.	Average per cent. germinated.
	6	3	600	8	41
	2	1	200	9	22
	1	1	100	20	0
	2	1	200	21	3
Tomato	8	7	800	0	89
	19	10	1400	1	85
	30	13	2050	2	89
	15	10	1400	3	89
	9	6	900	4	83
	5	2	500	5	71
	2	2	200	6	96
	5	4	400	7	74
	12	7	950	8	76
	5	3	500	9	83
	11	11	600	10	75
	2	2	150	11	63
	4	2	400	12	86
	3	2	300	13	44
	4	3	300	14	74
Turnip	6	3	600	0	95
	77	8	4100	1	87
	50	19	3400	2	95
	28	12	1900	3	94
	30	11	2150	4	79
	6	5	600	5	67
	3	3	300	6	58
	11	6	1000	7	56
	2	1	200	8	65
	2	2	100	12	49
Vetches	2	1	200	1	97
Watercress	1	1	100	2	27
	1	1	100	8	0
Wheat	3	3	300	0	100
Welsh Onion	1	1	100	1	30
	2	1	200	3	4
Wormwood	2	1	200	2	18
Yellow Locust	2	1	100	10	42
	2	1	100	27	12
Abies Douglassii	2	1	200	2	44
Nigra	2	1	200	2	52
Pinus insignis	2	1	200	2	81

Germination of Maize.—Lowest Temperatures.

The lowest temperatures at which our agricultural seeds can germinate seems not to have been satisfactorily ascertained. Thus, Thomè (Struct. and Phys. Bot., p. 209) says the growth of the embryos of maize at the expense of the reserve material begins at 9°.4 C. (48°.9 F.), which are the figures of Sachs (Text Book of Bot., 729), but experiments at the New York Agricultural Experiment Station indicate that germination takes place at an even lower degree of temperature and that there is a difference between the sums of temperature required for various of the form-species.

In Dec., 1884, as given in our 1884 report, two preliminary trials were made to test the apparatus for maintaining constant temperatures and to obtain suggestions for a more complete trial. The range of temperature was ascertained through hourly observations from 7 a.m. to 11 and 12 p.m. of a thermometer which had been carefully corrected to each degree with a standard. Seed from the same ears were used in these and succeeding trials, and the following data was obtained :

EXPERIMENT I.

Average temp. 52.1° F. Extremes 48.5° and 55.5° F.

	Hours.			
	First seed sprouted.	Half sprouted,	Last sprouted.	Per cent germinated.
Flint corn, 2 var.	141	171	209	100
Dent corn, 2 var.	140	140	185	100
Sweet corn, 2 var.	195	255	281	100
Soft corn, 2 var.	161	209	255	100
Pop corn, 2 var.	140	150	209	100

EXPERIMENT II.

Average temp. 48.2° F. Extremes 45.3° and 50.7°.

Flint corn, 2 var.	216	276	396	100
Dent corn, 2 var.	168	192	252	100
Sweet corn, 2 var.	288	348	408	100
Soft corn, 2 var.	228	312	408	100
Pop corn, 2 var.	228	276	396	100

Twice each day the seeds were carefully examined, and those which showed the acrospire just broken through the pellicle of the seed were removed. The lowest temperature maintained during any one period during which germinative changes appeared in Exp. I, was 54.5° and all the form species showed germination progress under this temperature. In Experiment II, we were more successful in maintaining low temperatures. The dents germinated during intervals when the highest temperature was 47.6° and the lowest 46.5°; the flints when the temperature varied from 46.5° to 47.8°; the sweets when 48.5° was the highest point reached; the softs when 48° was the highest; the pops below 47.8°.

Experiment III, was commenced Jan. 7, 1885, with one variety of each of the form-species, with the hope of maintaining a temperature constantly below 47°. The results are given below in somewhat more detail than in the preceding trials. The apparatus was opened at noon each day, and rise of temperature during the examination was guarded against by the use of snow. The duration of the trial 1008 hours.

EXPERIMENT III.

Variety and Form species.	Extremes of temp.	First germination. Hours.	Total per cent, germinated.	Per cent. left ungerminated.	Lowest temp. at which germination took place between two countings, and the hour.
"Chester Co. mammoth" Dent	43.5°—47.8°	264	100	0	45.1° bet. 264—288th hr.
"Waushakum" Flint	43.5°—47.8°	336	92	8	47.1° bet.384—432nd hr.
"Pearl" Pop	43.5°—47.8°	336	80	20	43.2° bet. 456—480th hr.
"Tuscarora" Soft	43.5°—49.6°	408	84	12	43.2° bet. 456—480th hr.
"Stowell's Evergreen" Sweet	41.7°—49.6°	504	84	12	45.3° bet.528—552nd hr.

It seemed probable therefore that germination could take place somewhere between 43° and 45°.

To test this question, a new apparatus was prepared, more complete than was used in the preliminary tests, and within which it was hoped a constant temperature, within one or two degrees, could be maintained, and in which the highest temperature should not exceed 43¾°, the fraction coming through the correction of the thermometer, degree by degree, with a standard. The maize seed from the same ears as heretofore used was put in the apparatus at 2 P. M. Feb. 9, with a temperature of 43¾°, and continued until 7 A. M. Feb. 19, when an accident to the apparatus occurred and the temperature rose to 47.2°. The seeds were at once examined, and germinations had occurred with the dents alone, yet the acrospire had almost broken through the pellicle in some of the pops, less so in the flints, and no marked change in the sweets other than the softening and swelling which comes from the absorption of water.

EXPERIMENT IV.

The thermometer readings during this trial, when noted, read as below, whereby it is seen that as at no one time the temperature exceeded 43¾°, the temperature of germination for dent corn must be below this point.

Hours.	Feb. 9.	Feb. 10.	Feb. 11.	Feb, 12.	Feb. 13.	Feb. 14.	Feb. 15.	Feb. 16.	Feb. 17.	Feb. 18.	Feb. 19.
7 A. M.		43°	43°¾	43°¾	43°	43°	43°¼	43°¼	41°½	43°	47¼°
8 “		“	43½	“	“	“	“	“	42½	“	
9 “		43	43¾	“	“	“	“	43¾	43	“	
10 “		“	43¾	“	“	“	“	43¼	“	“	
11 “		“	43¼	“	“	42¾	“	“	“	“	
12 noon		43½	“	“	“	43	“	“	“	“	
1 P M.		43¼	“	43½	“	“	“	“	“	“	
2 “	43°¾	43¼	“	“	“	“	“	“	“	“	
3 “	“	“	“	43¼	“	43¼	“	“	“	43¼	
4 “	“	“	“	“	“	“	“	“	“	43	
5 “	“	“	“	43	“	43¾	“	“	“	“	
6 “	“	“	“	“	43¼	“	“	“	“	“	
7 “	“	“	“	“	“	“	“	43	“	“	
8 “	“	“	“	“	43	“	“	“	“	“	
9 “	“	“	“	“	“	“	“	“	“	“	
10 “	“	43¼	43	“	“	“	“	“	“	“	
11 “	“	“	43¼	“	“	“	“	“	“	“	
12 “	“	“	“	“	“	“	“	“	“	“	

We note that the range of temperature is very small, on Feb. 17 the clock work ran down too far, but the outlets were closed and no harm was done as the temperature was descending; on Feb. 19, the same accident occurred, but the ventilators were left open and the temperature ascended, thus bringing the trial to an end. Assuming, as is perfectly legitimate, that the observed temperatures are an index for the unobserved hours, we have 168 hours out of 233 hours in which the following temperatures were recorded:—

Degrees.	Hourly No. of observations noted.	Assumed. Duration of temp. for whole period. Hours.
41½	1	4
42½	1	
42¾	1	
43	68	171
43¼	55	
43½	14	58
43¾	28	
	168	233

The conclusion, is therefore unquestionable, that Adams Early Dent, and Chester County Mammoth Dent Maize germinated in 233 hours at an average temperature of about 43.4°, with extremes of 14.5° and 43.7°, and the figures for the first germinations in the various trials for these dents are:—

Exp.	Average temperature.	Highest temp.	No. of hours required for germination.
I.	52.1	55.5	140
II.	48.2	50.7	168
III.	45.5	47.8	264
IV.	43.4	43.7	233

We note here that fewer hours were required for germination under the lowest temperature, than under a higher temperature. This possibly comes from the individual variability of the kernels, as in Exp. III for illustration. out of 25 seed of Tuscarora corn, 2 germinated on the 408th hour, and 1 on the 1008th hour, with 3 apparently sound yet not germinated after this interval; or possibly from the low temperature maintained in Exp. III just preceding the first germination.

The individual variation between seed, as shown by these germination trials, are very great, and hence we should not expect very exact correspondences in the number of hours required for the appearance of the acrospire at different temperatures, one trial giving different figures from another, unless large numbers of seed be used. It is also difficult to examine our seed without change of temperature occuring during the exposure to examination, and hence we must satisfy ourselves with examination as distant as will satisfy the conditions of the trial. In these later trials, we formed a judgment from earlier experiments as to about when the first germination was to be expected. At this period and after this, daily or not more frequently, the apparatus was opened, the rise of temperature restrained by the use of water at 36°, and each seed hastily examined, account only being made of the fact of, and not the numbers of, germination. We thus have Experiment V.

Experiment V.

Number of hours to first germination noted.

Extreme temperatures 41.5°——43.7° F.

Adams Early Dent	233
Chester Co. Mammoth Dent	233
Waushakum Flint	331
Eight-rowed White Flint	331
Tuscarora Soft	378
Zuni Blue Soft	431
White Pearl Pop	378
Amber Rice Pop	378
Dwarf Golden Pop	498
Stowell's Evergreen Sweet	452
Narragansett Sweet	498

EXPERIMENT VI.

(Different seed from formerly used.)

Number of hours to first germination noted. Trial 616 hours.

Extreme temperatures 41.5°——43.7°.

Dent.	Golden Beauty, Hend.	401
	Queen of the Prairie, Hend.	401
	Mammoth White Surprise, Hend.	479
	Farmers Favorite Golden, Hend.	521
Sweet.	Black Sugar, Hend	479
	Squantum, Hend.	498
	Mammoth, Hend.	616
	Hickox Improved, Hend.	616
	Stowell's Evergreen, Hend.	none.
Flint.	Golden Dew Drop, Hend.	498
	King Philip, Hend.	498
	Large Early 8-rowed, Hend.	521

We add, for the purpose of indicating the conflicting testimony which can accumulate during a trial, some tables of data with other varieties of seed, and a summary of the corn trials which were made.

Germination at Low Temperatures. Feb., 1885.

Temperature extremes 41.5° to 43.7° F.
First germination noted at hour.

	No. of seed used.	First germination noted at hour.	per cent. had germinated after 600 hours, or before.
Cabbage.			
Henderson's Selected Jersey Wakefield	100	93	100
Henderson's Early Summer	100	64	100
Cauliflower.			
Half Early Paris	100	160	65
Celery.			
White Plume	100		
Corn Salad.			
Large Seeded	100	209	94
Kohl-Rabi.			
White Vienna	100	93	72
Kale.			
Siberian	100	93	82
Lettuce.			
Salamander	100	93	87
Onion.			
White Portugal	100	209	99
Yellow Danvers	100	209	88
Red Wethersfield	100	93	95
Red Italian Tripoli	100	64	89
Pea.			
Henderson's First of All	25	160	100
American Wonder	25	160	100
Champion of England	25	160	100
Black-eyed Marrowfat	25	160	96
Tomato.			
Perfection	100		0
Turnip.			
White Strap-leaved	100	160	82
Red top Strap-leaved	100	93	81
Purple-top White Globe	100	93	37
Ruta Baga.			
Improved American Purple-top	100	93	98

Germination at Low Temperatures. Feb., 1885.

First germination in hours.

		Extreme temperatures maintained.				
	No. of seed.	41°—43.5°	41°—44.2°	41°—44.6°	41°—45.3°	44.4°—47.6°
Cabbage.						
Henderson's Selected Jersey Wakefield	100	93	120		159	168
Henderson's Early Summer	100	64	120		63	
Kohl-Rabi.						
White Vienna	100	93		167	159	168
Kale.						
Siberian	100	93	120		112	168
Lettuce.						
Salamander	100	93	120		112	
Onion.						
Red Wethersfield	100	93	304		63	
Red Italian Tripoli	100	46 & 64			63	
Turnip.						
Red-top Strap-leaf	100	93			112	
Purple-top White	100	100 & 93			112	
Ruta Baga.						
Improved American Purple-top	100	93			112	

Germination at Low Temperatures. Dec., 1884—Mar., 1885.

First germination in hours.

			Extreme temp. noted.		
	41°—43.7°	43.5°—47.8°	41°—49.6°	45.3°—50.7°	48.5°—55.5°
MAIZE.					
Dent Form—Species.					
Adams Early	233			180	142
Chester Co. Mammoth	233	264		168	142
Golden Beauty	401				
Queen of the Prairie	401				
Mammoth White Surprise	479				
Farmers Favorite Golden	521				
Flint Form—Species.					
Waushakum	331	336		228	142
Eight-rowed White	331			216	150
Golden Dew Drop	498				
King Philip	498				
Pop Form—Species.					
Dwarf Golden	498			228	141
White Pearl	378	336		228	141
Amber Rice	378			228	141
Sweet Form—Species.					
Stowell's Evergreen	452		504	288	195
Narragansett	498			300	209
Black Sugar	479				
Squantum	498				
Hickox Improved	616				
Mammoth	616				
Large Early 8-rowed	521				
Soft Form—Species.					
Tuscarora	378		408	228	161
Zuni Blue	431			228	185

The percentage of germination after given intervals is noted in the table below, the hours in brackets, the percentage of seed apparently sound in parenthesis. Whole trial 616 hours.

	41°—43.7°.	40.8°—44.6°	41°—45.3°.	At temperature of Office. Duplicates.	
Cabbage.					
Henderson's Selected Jersey Wakefield	100 [600]	98 [396] (0)	99 [520] (1)	95	97
Henderson's Early Summer	100 [600]	100 [396]	100 [520]	97	99
Cauliflower.					
Half Early Paris	65 [400] (35)				
Celery.					
White Plume	0 [616]				
Corn Salad.					
Large Seeded	94 [600]				
Kohl-Rabi.					
White Vienna	72 [400] (28)	66 [396] (34)	78 [520] (22)	86	89
Kale.					
Siberian	82 [400] (18)	98 [396] (2)	98 [520] (2)	96	97
Lettuce.					
Salamander	87 [400] (0)	91 [396] (0)	98 [520] (1)	34	40
Onion.					
White Portugal	99 [600] (1)				
Yellow Danvers	88 [400] (12)				
Red Wethersfield	95 [400] (5)	84 [396] (16)	91 [520] (9)	95	97
Red Ital. Tripoli	89 [400] (11)	67 [396] (33)	93 [520] (7)	98	98
Pea.					
Henderson's 1st of All	100 [160]				
Amer'n. Wonder	100 [160]				
Champion of England	100 [160]				
Black-eyed Marrowfat	96 [400] (0)				
Tomato.					
Perfection	None [616] (100)				
Turnip.					
White Strap-leaved	82 [400] (18)				
Red-top Strap-leaved	81 [400] (19)	97 [396] (3)	92 [520] (8)	92	95
Purple-top White Globe	37 [400] (63)	88 [396] (12)	85 [520] (15)	87	92
Ruta Baga.					
Imp. American Purple-top	98 [400] (2)	100 [396]	100 [520]	93	95

The hours in the brackets are the record of when the count was made; the germinations in many cases were long previous to this.

	41°—43.7°	.41°—45.3°.	43.5°—47.8°.	41.7°—49.6°.	48.5°—55.5°.
Dent Corn.					
Adams Early	100 [738]		100 [252]		100 [185]
Chester County Mammoth	100 [738]	100 [408]	100 [252]		100 [185]
Golden Beauty	68 [616] (32)				
Queen of the Prairie	88 [616] (52)				
Mammoth White Surprise	48 [616] (52)				
Farmers' Favorite Golden	28 [616] (72)				
Flint Corn.					
Waushakum	100 [738]	92 [624] (8)	100 [312]		100 [185]
8-rowed white	84 [738] (16)		100 [396]		100 [209]
Gold'n Dew Drop	44 [616] (56)				
King Philip	68 [616] (32)				

	41°—43.7°.	41°—45.3°.	43.5°—47.8°.	41.7°—49.6°.	48.5°—55.5°.
Pop Corn.					
Dwarf Golden	18 [738] (82)		100 [360]		100 [171]
White Pearl	44 [738] (56)		100 [396]	80 [1008] (20)	100 [195]
Amber Rice	46 [738] (54)		100 [396]		100 [209]
Sweet Corn.					
Stowell's Everg'n	62 [738] (38) 0 [616]		100 [396]	84 [1008] (16)	100 [255]
Narragansett	60 [738] (40)		100 [408]		100 [281]
Black Sugar	92 [616] (8)				
Squantum	20 [616] (80)				
Hickox Improv'd	8 [616] (92)				
Large Early 8-rowed	24 [616] (76)				
Mammoth	4 [616] (96)				
Soft Corn.					
Tuscarora	50 [738] (50)		100 [396]	84 [1008] (16)	100 [255]
Zuni Blue	74 [738] (26)		100 [408]		100 [255]

An incomplete trial, incomplete on account of the disarrangement of the apparatus on the 450th hour, gave even lower germinations for maize than heretofore reported. From 11 A. M., Mar. 16, 1885, to 4 P. M., April 4, the temperatures maintained varied from 37° to 42° F. The examination of the thermometer in with the seeds, as a check upon the thermostat, counted 210 readings. Of these four were 37°, one 37½°, twelve were 38°, twenty-eight were 38½°, one hundred and eight were 39°, twenty were 39½°, thirty-two were 40°, one was 40½°, two were 41°, and two were 42°. The two 42° readings were at 9 and 10 A. M., April 3, when the apparatus halted until the rise was discovered, the 8 and 11 A. M. readings being 40°. We may hence say that the germinations that occurred were below 41° F.

The Chester County Mammoth showed first germination in 430 hours; the Waushakum in 460 hours, the Amber Rice so near germination as to be doubtfully rejected. The apparatus after the 4 P. M. count, April 4, was left exposed to the temperature of the office, say 72° to 78° F., and at 8 A. M. April 5, or sixteen hours after, the following per centage of germinations had occurred, viz :

	Germinated.	Seed almost germinated.
Chester County Mammoth Dent	100 per cent.	—
Stowell's Evergreen Sweet	73 per cent.	27
Tuscarora Soft	92 per cent.	8
Amber Rice Pop	100 per cent.	—

And at 4 P. M. the germinations were noted at 100 per cent. for all, the radicles or acrospires extending from ⅛ to ⅝ inch from the seed.

CURIOUS OBSERVATIONS UPON GERMINATION.

March 12, 1885. A very curious circumstance may be mentioned in regard to germination. After one box containing the seeds exposed to low temperatures, below 45.3° for 520 and 396 hours was removed from its refrigerator, it was at once set over a gas flame in order that an hour or more boiling might destroy all germs of mold, and clean the cloth for further trials. After about one hour and a half boiling it was allowed to cool down a little, when it was accidentally looked into, and some seed left over was seen to be apparently nicely germinated. The number of seed left over, and which apparently germinated while the apparatus was exposed to boiling is shown in the following table:

The 520 hours trial.	Per ct. germinated at low temp.	Seeds left.	Of the Seeds left germinated at once upon boiling.
Red Wethersfield Onion	91	9	1 or 1 per cent.
Red Italian Tripoli "	93	7	7 or 100 "
The 396 hours trial.			
White Vienna Kohl Rabi	66	34	3 or 10 "
Red Wethersfield Onion	84	8	4 or 50 "
Red Italian Tripoli "	67	31	18 or 60 "

White Plume Celery, which had not germinated in 616 hours at a temperature below 43°.7, and which was exposed to the boiling process, through accident, germinated 21 per cent., or rather gave every appearance of germination, but the shoots were all cooked.

In order to test further in accordance with this hint, three lots of White Tripoli onion seed were put into the damp pockets, left for three hours to soften, and the box then placed over the gas flame. In five minutes, the water boiled, and the steam penetrated the folds of cloth containing the seeds. After ten minutes of boiling, the gas was shut off, and the apparatus allowed to cool down. In one hour more it was examined, and a few seed in each pocket had germinated, the young shoots being up to three sixteenths of an inch long. We have hence germination, or the appearance thereof, in four and one quarter hours.

On March 13, 70 White Tripoli onion seed put into pocket to dampen at 8 A. M. At 9 A. M. the apparatus put over flame. In 5 minutes the water was at a boil, and was kept boiling for five minutes. At 12 noon, no germination. The apparatus was again put over the gas flame, boiling occurred in five minutes; in five minutes more the temp. of the pockets was 180°; in ten minutes more 190°, when the gas flame was turned off. At 12 h. 35 m., P. M., the temp. was 150°; at 1 h. 20 m., P. M., the temp. was 100° and one seed had germinated.

At 10 A. M. two pockets of the same apparatus received seed, which was allowed to soak until 12 noon, when the water was boiled, and the temperatures attained were as above given. At 1 h. 20 m., P. M., one seed had sprouted.

We observe, however, that although the water below the seeds was boiling, yet the temperature did not exceed 190° in the steam saturated germinating cloth above.

Mar. 14. At 8 A. M. the Perfection Tomato seed had germinated since last night ten per cent. The story of the seed is as follows: One hundred seed put into cold germinator Feb. 14, at 4 P. M., and exposed to a temperature of below 43.7° for 616 hours. Then left in the pan over water boiling for an hour and a half. A few hours afterwards, having been neglected in the pockets, it underwent the two additional boilings as stated for the onion seed the temperature noted at 190° F. Happened to be observed at 6 P. M. March 13, when there was no germination noted; at 8 A. M. Mar. 14, 10 per cent. had germinated.

An interesting experiment upon the effect of drying seed corn, is appended, the seed in all the trials being taken from the same bin.

EXPERIMENT I.

No. 1. Waushakum Flint Corn, as taken from bin, March 9, 1885.
No. 2. " " exposed to temp. of 206 for 42 hours.
No. which had germinated at each daily count.

	1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	Total days of trial.	Per cent. germinated.
No. 1	0	3	12	45	28	12	6	100
No. 0	0	0	0	0	0	0	12	0

EXPERIMENT II.

No. 1. Waushakum Flint corn, dried at 120° for 3 days.
No. 2. Same corn further dried at 206° for 24 hours.
No. which had germinated at each daily count.

	1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	7th day.	8th day.	9th day.	10th day.	12th day.	15th day.	Total days of trial.	Per cent. germinated.
No. 1.	0	0	15	69	11	3	—	—	—	—	—	—	9	98
No. 2.	2	0	12	2	4	8	6	3	5	6	15	4	15	65

No. 2 mildewed very badly in 3 pockets. The 25 kernels in the fourth pocket germinated 100 per cent.

EXPERIMENT III.

No. 1. Waushakum Flint corn dried at 95° for four days.
No. 2. Same corn further dried at 206° for 24 hours.

	1st day.	2nd day.	3rd day.	4th day.	Total days of trial,	Per cent. germinated.
No. 1.	0	46	48	5	8	99
No. 2.	13	43	30	14	4	100

EXPERIMENT IV.

No. 1. Waushakum Flint corn dried at 90° for 3 days.
No. 2. Same corn further dried at 206° for 24 hours.

	1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	Total days of trial.	Per cent. germinated.
No. 1.	0	0	3	62	33	1	7	99
No. 2.	0	11	66	20	1	1	6	99

These figures correspond to a mass of unrecorded experiences which tends to show that thoroughly dried corn germinates more quickly than does ordinary seed corn, or that corn dried at a high temperature, say 90°--100° is superior for seed uses.

A STUDY OF MAIZE.

Attempt at forming a new variety.

In 1882, we grew a small patch of Pod or Husk corn, from seed received from Professor Beal, of the Michigan Agricultural College. The crop of this year had a number of variables, from which fourteen were selected for planting in 1883, among which were some red dent kernels from an unhusked ear. From the variables of this planting some white sweet kernels were selected for planting in 1884. Among the variables of this crop there appeared one ear of sweet corn, of which the following is the description:

Ear small, 5¼ in. long, 1¾ in. in greatest diameter: ear stalk very small, cupped, ear very strongly rounded towards but and strongly tapering, which allows it to be described as fusiform: kernels white, very deep, narrow and thick, not in contact: many rowed: cob small, white.

This ear represented a variety of great promise, provided it could be retained. Its seed was therefore planted in a remote position in order to guard against cross-fertilization with other varieties, 121 hills, May 19, 1885. The vegetation and growth was excellent, but smut was exceedingly prevalent. At harvest, Oct. 13, there were 244 smutty stalks and 257 stalks apparently free from smut. The crop was very late, and there were but 310 ears harvested, of which 8 were smutted. But 258 ears were in a condition to be studied, and these gave 120 ears of red sweet corn, and 138 ears of white sweet corn, with white and pink cobs about equally distributed.

The red ears were all of one shade, many were strongly tapering, even to cone-like, and some were fusiform, and no effect from current cross-fertilization appeared.

The 138 white ears yielded but eleven which were closely resembling the ear planted; thirty-seven which might be called fusiform; eighty-nine strongly tapering; one white ear of unhusked dent Pod corn with a few sweet kernels intermixed. Some of the ears had a few purple sweet and yellow sweet kernels intermixed, and a very few yellow dent kernels.

The noticeable features of this trial are: 1st, Not a single ear was as good as the one which furnished the seed. 2nd, Only about 35 per cent. of the ears were of the type of the ear planted. 3rd, The majority of the ears were of the cone-form type so common in the crops from our Pod corn. 4th, One ear was dent, and precisely of the type of the unhusked dents described in our 1883 report. 5th, There was but very little current fertilization, and no more than might legitimately be accredited to the variables produced from the seed used.

Another interesting feature is the great diminution in the crop produced by the smut on the plant, and the few harvested ears which showed smut. As the Pod corn with us was particularly subject to smut, and as the kernels from but one ear were used, the great prevalence of smut in the crop would indicate very strongly its transmission through agency of the seed planted.

Variations from Seed.

In a paper read before Section F. American Association for the Advancement of Science at the Ann Arbor meeting; and published in full with additional notes in the American Naturalist, Nov., 1885, p. 1040, I stated;—

"*Maize.*—Seed of one kind sown often produces samples of other kinds of corn in the crop, and these varieties can usually be distinctly referred by name to varieties with which the original seed might have been crossed. Purposely hybridized seed has produced the original parentage without intermediate types, and seed exposed to hybridization during two years with many sorts of corn, has yielded ears of the types of corn with which cross-breeding or hybridization has been effected, without appearance of intermediate forms."

The possession of colored drawings of most of the varieties grown at the Station the past few years, renders possible the identification of variations, and enables us to ascribe most of the ears of our crop to one or the other of the varieties figured in our report for 1884. Where the identification is by picture and memory combined, we use the word 'resemble;' when fully identified by specimens we use the name of the variety only, without qualification. The number following the name of the standard varieties is the number used in the descriptive part of our 1884 report. In a number of cases our knowledge was not sufficient to make a certain identification, and in the case of the pops we have omitted in general the references to varieties not as yet named by us.

The plantings of our 148 different selections were on May 18 and 19, four or five hills of a kind, in a compact plat, and so arranged as to secure the greatest natural admixture possible through the prevalence of the pollen of each variety throughout. The notes on the crop together with the seed used are given below, and the 1884 number is appended whereby the possible cross-fertilizations can be traced.

SWEET CORN.

No. 4.. WHITE SWEET POP KERNELS from No. 1846 of 1884.

Seventeen ears all white sweet, with pink, white, yellow and black flinty kernels of pop size. I cannot identify the ears with varieties.

No. 8. AMBER SWEET KERNELS from Brighton Orange (12 rowed), No. 1805 of 1884.

Eleven ears 10-rowed, 6 ears 13-rowed. Some ears resemble Tom Thumb, No. 6, with some yellow and white flint kernels. Other ears resemble Orange, No. 16, with a few black sweet, white and yellow flint kernels. Compare Nos. 55, 91, and 92 of this year.

No. 14. STOWELL'S EVERGREEN. Sta. 1884.

Sixteen ears, very unripe. Some dent kernels intermixed.

No. 16. PINK KERNELS AND COB, Early Marblehead. No. 1813 of 1884.

Fifteen ears, some on type, with a very few flint kernels ; a few ears Amber Queen, No. 20, but many flesh-colored flint kernels.

No. 17. NARRAGANSETT. Sta. 1884.

Sixteen ears, seven on type with yellow and slate flint kernels intermixed; some on type, but deep red, and deep red flint kernels ; some ears resembling Wyoming No. 8, in ear, but Narragansett colored kernels, and a few flint kernels.

No. 23. GOLDEN SWEET KERNELS from 1867 of 1884.

Twenty-one ears; some Golden Eight-rowed, No. 13, with a few black sweet, white and golden flint kernels; some ears Black Mexican, with some amber and golden sweet, and white, olive, slate and black flint kernels. Compare No. 49 sweet and No. 111 flint of this year.

No. 28. WHITE SWEET POP, from No. 1844 of 1884.

Nineteen ears; some ears resemble Darling's Early, No. 9, with a few yellow flint kernels; some ears Marblehead, No. 2, with a few flesh colored and yellow flint kernels; one ear I cannot identify. See No. 34 of this year.

No. 29. BANANA SUGAR, Farquhar.

A new variety. Ear 5 in. long, 1½ in. in diameter, rounding over but to a small ear stalk, rounding evenly at the well-filled tip, slightly tapering both ways from just above the center, thus being fusiform. Rows quite irregular, 18 to 20 in number. Kernel very deep, narrow and thick, shrivelled and wrinkled, white, as also the cob. Season very late; it vegetated May 29, bloomed Aug. 12, silked Aug. 17.

Seventeen ears in crop, all on type, but some ears with a few white and blue dent kernels.

No. 33. NARRAGANSETT. No. 1815 of 1884.

Twenty ears, on type; some flesh colored flint kernels.

No. 34. WHITE SWEET POP, Eight-rowed, large kernelled, from No. 1844 of 1884.

Twelve ears; some resembling Minnesota, No. 5, with some white and yellow flint kernels; some Amber Cream, No. 20, with some black sweet and yellowish flint kernels. See No. 28 of this year.

No. 36. PEE AND KAY, Thorb.

A new variety of this year. As we grew it 3 ears were 12-rowed, 8 were 10-rowed, and 7 were 8-rowed. Some ears were Crosby's Early, No. 18, some resembled Minnesota, No. 5; some resembled Darling's Early, No. 9. Compare with No. 51 of this year.

No. 40. MINNESOTA. No. 1814 of 1884.

Four ears were 10-rowed, 14 were 8-rowed. Some ears resembled Eight-rowed Early No. 11, with some black sweet, white and yellow flint kernels; the ten-rowed kernels Amber Cream, No. 20, with some black sweet and flesh-colored flint kernels; a few ears were on type, with some black sweet, and white and yellow flint kernels. Compare No. 90 sweet and 71 flint of this year.

No. 43. MOORE'S EARLY. No. 1826 of 1884.

Seventeen ears; some resembling Golden Eight-rowed, No. 13, with some yellow flint and amber sweet kernels; some ears on type, but with some white and yellow dent kernels. Some of these dent kernels appear flint until cut into, and some seem to occupy the border line between flint and dent. Compare No. 94 flint of this year.

No. 44. PERRY'S HYBRID, Thorb.

A new variety. Three ears 8-rowed, 13 ears 10-rowed, 3 ears 12-rowed. The 8-rowed ears resembling Marblehead, No. 2, with some black sweet and olive and yellow flint, and a few Benton dent kernels. Other ears are on type, with golden and black sweet kernels and white and yellow soft and flint kernels interspersed.

No. 49. BLACK SWEET kernels from No. 1867 of 1884.

Twenty-two ears, all Black Mexican, No. 14, but amber, pink, and black sweet, and white, yellow, golden, purple, slate and black flint and soft kernels, the colors very distinct and the intermixture making very handsome ears reminding of Mandan. Compare No. 23 sweet and 111 flint of this year.

No. 50. ASYLUM. No. 1802 of 1884.

Twenty-one ears; some ears on type, but with some flint kernels; some ears Amber Cream No. 20, with some flesh colored and purplish flint kernels; some ears Crosby's Early, with some pink and black sweet, and a few white and yellow flint kernels.

No. 51. PEE AND KAY, Greg.

A new variety. 4 ears were 8-rowed, 10 were 10-rowed, 5 were 12-rowed, 1 ear 16-rowed. The latter too unripe for study. Some ears resembled Minnesota, No. 5, with a few black sweet, yellow and white flint kernels; other ears resembled Asylum, No. 21, with some black sweet, yellow and white flint kernels. Compare with No. 36 of this year.

No. 52. ALEXANDER'S SWEET, 8-rowed. No. 1800 of 1884.

Sixteen ears; some Amber Cream, No. 20, with a few blackish sweet, a few golden flint, and some half sweet and half flint kernels. Some ears resemble 8-rowed Early, No. 11, with a few black sweet and white flint kernels; some ears on type, with a few black sweet and amber flint, also red striped amber flint kernels.

No. 55. BLACK SWEET KERNELS from 1805 of 1884.

Twenty-two ears; all Black Mexican, No. 14, with some amber and golden sweet, white, yellow, olive, slate and black flint kernels. Compare No's. 8, 91, and 92, of this year.

No. 59. EIGHT-ROWED EARLY. No. 1811 of 1884.

Twenty-three ears, on type, with some black, sweet, white and yellow flint kernels.

No. 62. DOLLY DUTTON. No. 1809 of 1884.

Twenty-five ears; some resembling Narragansett, No. 3, with many yellow and white flint and some black sweet kernels ; some ears on type, with many yellow and white flint and some black sweet kernels; one 12-rowed ear not recognized, it being too imperfect.

No. 65. GENESEE. No. 1812 of 1884.

Seventeen ears, all on type, but some black sweet and yellow flint kernels.

No. 68. BLACK SWEET KERNELS from No. 1838 of 1884.

Twenty-seven ears; some Black Sugar, No. 25, with a very few white sweet, golden sweet, and black or blackish flint kernels; some ears Crosby's Early, No. 18, with many black sweet, yellow and black flint kernels; some ears resemble Dwarf Early, No. 10, with many black sweet, yellow and black flint kernels. Compare No. 80 of this year.

No. 70. ROSE'S IMPROVED EVERGREEN, Till.

A new variety. Fifteen ears on type, but some black sweet, white and yellow flint kernels.

Very close to Egyptian, No. 19; 11-rowed; ear cylindrical, rounding about equally at tip and but; ear stalk rather smallish ; cob white; kernel as deep as broad, wrinkled. Color white.

No. 77. WHITE SWEET KERNELS from No. 1840 of 1884.

Eighteen ears. One ear of the unhusked pod corn type described in 1883, and with sweet and dent kernels; six ears resembling Moore's Early, No. 19; one flint ear very near Dutton; ten ears alike, but I cannot place. Many various colored kernels common on all the ears. Compare No. 139 of this year.

No. 78. WHITE MARBLEHEAD EARLY, Greg.

A new variety. Sixteen ears, a portion on type with white, yellow and blue soft and flint kernels interspersed; others Marblehead, No. 2, with some flint red striped kernels.

No. 79. EXTRA EARLY CROSBY, Greg.

Eighteen ears. A few resembling Eight-rowed Early, No. 11, the kernels white, amber and black sweet, white, yellow, olive, slate black, etc., flint very evenly intermixed; the majority of the ears Crosby's Early, No. 18, with a few black sweet and yellow and white flint kernels.

No. 80. BLACK SWEET AND FLINT IN SAME KERNEL from No. 1838 of 1884.

Twenty-nine ears. Some resembling Eight-rowed Early, No. 11, but kernels all black sweet, with some black flint; some ears Crosby's Early, No. 18 with amber and black sweet, and yellow, white and slate flint kernels. Compare No. 68 of this year.

No. 84. BLACK MEXICAN, No. 1804 of 1884.

Nineteen ears ; one ear Amber Cream, No. 10, in shape, but the kernels black mostly; the other ears on type, the color mostly black, but some amber sweet, chocolate, slate, black, etc., flint kernels. Compare No. 157 sweet and No. 61 flint of this year.

No. 86. NE PLUS ULTRA. No. 1817 of 1884.

Twenty-one ears. Some ears resembling Eight-rowed Early, No. 11, but with flint kernels intermixed; one ear resembles Hickox, No. 11, and with some soft kernels intermixed; other ears on type, with dent kernels intermixed. Compare No. 53 dent of this year.

No. 88. YELLOW SWEET KERNELS from No. 1871 of 1884.

Nineteen ears. Some ears resemble Golden Eight-rowed No. 13, with some golden yellow flint and blackish sweet kernels; some ears resemble Golden, No. 24, with a number of golden yellow and brown dent kernels; one ear may be described as Benton Dent, No. 1, with many amber, golden and blackish sweet kernels of large size. Compare No. 24 dent of this year.

No. 90. HALF SWEET, HALF FLINT KERNELS from No. 1814 of 1884.

Twenty-two ears. Some ears resemble Minnesota, No. 5, with some black and golden sweet, white and yellow flint kernels; some ears resemble Narragansett, No. 3, with some black sweet and flesh colored flint kernels; some ears resemble Eight-rowed Early, No. 11, with some black and golden sweet, lemon and yellow flint kernels. Compare No. 40 sweet and 71 flint of this year.

No. 91. BLACK SWEET KERNELS from No. 1805 of 1884.

Five ears 12-rowed, 10 ears 10-rowed, 18 ears 8-rowed. A few ears resembling Orange No. 16, but very many black and purple sweet, and some white, yellow, purple and slate flint kernels; the ears mostly however, Black Mexican, No. 14 with some amber sweet and many white, yellow, and slate to black flint kernels. Compare Nos. 8, 55 and 91 of this year.

No. 91. WHITE SWEET KERNELS from No. 1805 of 1884.

Twenty-one ears; some resembling Tom Thumb, No. 6, with some black sweet, yellow and white flint kernels; some Crosby's Early, No. 18 with some pink, flesh-colored and black sweet, yellow and white flint kernels. Compare Nos. 8, 55 and 91 of this year.

No. 96. TOM THUMB. No. 1836 of 1884.

Fifteen ears. Many ears on type, with some black sweet, white and yellow soft kernels; some ears resembling Minnesota, No. 5, with some black sweet, white and yellow soft and flint kernels.

No. 102. WHITE SWEET KERNELS from No. 1903 of 1884.

Four ears 6-rowed, 11 ears 8-rowed, 1 ear 10-rowed. The ears I cannot place, if flint as they appear to be, for they are much mixed with black, slate, red, blue, etc., flint kernels, but many sweet kernels also; if supposed to be sweet, with the flint kernels from current hybridization, they may resemble Darling's Early, No. 9.

No. 103. DWARF EARLY. No. 1810 of 1884.

Nineteen ears; some ears on type, with some black sweet, white, yellow and black flint kernels; some ears resemble Eight-rowed early, No. 11, with some white, yellow and black flint kernels; some Crosby's Early, No. 18 with some white, yellow and black flint kernels.

No. 106. RUSSELL'S EARLY PROLIFIC, Ferry.

A new variety. Twelve-rowed; ears slightly but regularly tapering, and rounding greatly at but, rounding evenly at tip; kernel deeper than broad.

Fifteen ears, on type, with some purple, white and yellow dent kernels.

No. 113. CLARK'S OLD COLONY SWEET. No. 1807 of 1884.

Eighteen ears on type, but very many white and yellow flint kernels.

No. 119. LANDRETH'S SUGAR. No. 1823 of 1884.

Twenty-four ears; one ear resembling Long Yellow Flint, No. 23, except the color a brighter shade, and many sweet kernels intermixed, some of which are black purple; the other ears on type, with dent kernels intermixed. Compare No. 15 dent of this year.

No. 121. BURR'S IMPROVED, No. 1806 of 1884.

Seventeen ears, all on type, but a few yellow dent kernels.

No. 128. MARBLEHEAD MAMMOTH. No. 1825 of 1884.

Fourteen ears; some resemble Genesee, No 17, with some white and yellowish flint kernels; other ears on type, but with amber and golden sweet, and very many yellow and white dent kernels. Compare No. 105 flint of this year.

No 132. AMBER CREAM. No. 1801 of 1884.

Seventeen ears; some ears on type, with many yellow flint kernels, and a few black sweet; some ears Crosby's Early, No. 18, with some black sweet and yellow flint kernels.

No. 135. CORY, Greg.

Eleven ears 8-rowed, 5 ears 10-rowed. One ear resembles Marblehead, No. 2; many ears on type, with many yellow and blue flint kernels. Part of the crop edible Aug. 29, and a portion not ripe at harvest Sept. 23, and these unripe ears not studied.

No. 137. BLACK MEXICAN, 8-rowed. No. 1804 of 1884.

Twenty-six ears; six ears 8-rowed, Black Mexican, No. 14, with some white sweet, yellow, white and dingy flint kernels; fifteen ears 10-rowed, and Black Mexican, No. 14, with variously colored flint and soft kernels; five ears 12-rowed, quite unripe, resembling Black Sugar, No. 25, with some dent and some perhaps soft kernels, but no flint. Compare No's 84 sweet and 61 flint of this year.

No. 138. GOLDEN SWEET, 12-rowed. No. 1821 of 1884.

Eleven ears 8-rowed, 2 ears 10-rowed, 1 ear 12-rowed. The 8 and 10-rowed resembling Golden eight-rowed, No. 13; the 12-rowed resembling Golden, No. 24. A few golden flint kernels on the Golden Eight-rowed ears. Compare No. 100 flint of this year.

No. 139. DEEP RED SWEET kernels from No. 1840 of 1884.

Eleven red ears, thirteen white ears, all sweet. Some red dent kernels on the red sweet ears, and some black sweet, and white dent on the white sweet ears. The types of the crop are those of the unhusked dent Pod corns; there is great irregularity in the ripeness of the various ears. Compare No. 77 of this year.

No. 140. SQUANTUM. No. 1834 of 1884.

Twenty-six ears. Some resemble Genesee, No. 17, with some flint kernels; others on type, with some dent and soft kernels.

No. 141. EGYPTIAN. No. 1818 of 1884.

Eighteen ears; some ears Crosby's Early, No. 18, with some black sweet and white flint kernels; many ears on type, with a few dent kernels, and very unripe. Compare No. 39 flint of this year.

No. 143. POTTER'S EXCELSIOR. No. 1831 of 1884.

Twenty-six ears on type, with some flint kernels, deeper than broad, and white and yellow in color.

No. 145. WHITE SWEET KERNELS from 1839 of 1884.

Seven red sweet ears, eight white sweet ears; all of the unhusked Pod corn type, the majority of the kernels sweet, the others dent. Compare No. 32 dent of this year.

No. 147. SCOHARIE. D. Bouck.

Sixteen ears; the most of these too unripe for study, but a few which resemble Darling's Early, No. 9, have some white yellow and blackish flint kernels.

No. 148. CALIFORNIA. D. Bouck.

Nine ears; too unripe for study.

FLINT CORN.

No. 6. WAUSHAKUM. Sta. 1884.

Twenty-three ears, all on type, a very few discolored flint kernels.

No. 7. FRENCH YELLOW SIX WEEKS, Vaughan.

Two ears on Quarantino, and no off kernels; fourteen ears on type, with a very few brown flint kernels.

No. 10. COMPTON'S EARLY. No. 1850 of 1884.

Sixteen ears; a few Canada 12-rowed, No. 29, with some white sweet and white flint kernels; other ears on type, with a few blackish flint kernels.

No. 19. EIGHT-ROWED WHITE, Thorb. Sta. 1884.

Twenty-three ears, on type, some few yellow and blue flint kernels.

No. 25. NEW ENGLAND 8-ROWED. No. 1866 of 1884.

Twenty-two ears 8-rowed, 1 ear 12-rowed. Some ears on type; some ears Long Yellow, No. 23; some ears Canada 12-rowed, with many amber and black sweet, and white and black flint kernels. Compare No. 89 of this year.

No. 27. MAIZE FROM AFRICA, A. No. 1910 of 1884.

Twenty-three ears; three ears were Pod, and resembled the podded ears of 1883 description. Some ears resembled Chinese Golden, No. 39, and the type of the seed planted; some ears resembling African E. 3 dent, No. 37, but yellow kernels instead of white, and some brown dent kernels; one ear was a 12-rowed flint, which I cannot place; one red ear, quite unripe, but resembling African Dent E. 3, No. 37.

No. 31. CHAMPION WHITE PEARL, Greg.

Eighteen ears. Too unripe for study; at edible maturity Sept. 16.

No. 39. WHITE FLINT KERNELS from No. 1818 of 1884.

Twenty-three ears; one ear resembles Egyptian Rice Pop, all white kerneled; some ears resemble Canada, No. 2, with some black flint, black, amber and golden sweet kernels; some ears resemble Chinese Golden, No. 39, but the color lighter, and some amber sweet and purple flint kernels; one lot resembles, but are not, Early Dutton, No. 31, with some amber and black sweet kernels. Compare No. 141 sweet of this year.

No. 41. RURAL THOROUGHBRED, white kernels. No. 1860 of 1884.

Twenty-one ears. Some ears Rhode Island White Cap, No. 15, of perfect type, and with a few yellow flint kernels; some ears resemble Benton Dent, and are scarcely ripe; some ears on type, but very unripe. No off kernels except yellow and white flint on the flint ears, and dent on dent ears.

No. 42. RHODE ISLAND WHITE CAP. No. 1859 of 1884.

Seventeen ears, all on type; a few discolored flint kernels.

No. 46. RED BLAZED, Ferry.

Sixteen ears, mostly on type with some few dark purple flint kernels; a few ears resembling Long Yellow, No. 23, with a few blackish flint kernels.

No. 57. YELLOW VERY LONG FLINT kernels from Benton Dent. No. 1874 of 1884.

Seventeen ears; some Benton Dent, No. 1, precisely on type, some few slate dent kernels; some ears Waushakum, No. 5, precisely on type, a very few discolored flint kernels; some ears Eight-rowed Brown, No. 12, precisely, and no off kernels; some ears resemble Orange Flint, No. 6, and a number of olive, speckled, whitish, etc., flint kernels. Compare No. 69 dent of this year.

No. 61. BLACK FLINT KERNELS from 1804 of 1884.

Twenty-one ears; mostly Black Mexican Sweet, No. 14, with a few black flint kernels; a few ears 10-rowed, and resembling Black Sugar, No. 25, with black and white sweet and flint kernels intermixed. Compare Nos. 84 and 137 sweet of this year.

No. 63. JAPANESE STRIPED. No. 1919 of 1884.

All ears appear on type, but too unripe for satisfactory study. Bloomed Aug. 31, silked Sept. 5.

No. 71. YELLOWISH FLINT KERNELS from 1814 of 1884.

Twenty-four ears; some ears resembling Genesee Sweet, No. 17, a few black sweet, yellow and white flint kernels; one red ear coarse New England Pop, with red sweet kernels intermixed; some ears coarse New England Pop type, with some black flint and many white sweet kernels. Compare Nos. 40 and 90 sweet of this year.

No. 74. AFRICAN MAIZE, E. 1. No. 1911 of 1884.

Twelve ears; all Chinese Golden, No. 39, some few black and speckled flint kernels; no sign of a spine to the kernel as in the seed used.

No. 82. CHOCOLATE FLINT KERNELS from No. 1901 of 1884.

Nineteen ears, one six-rowed, the balance 8-rowed. Ears on type of Mandan, but the kernels mostly flint, yet a few soft and sweet kernels are noted. The chocolate color prevailing, but white, yellow, brown, black, etc., occur.

No. 83. CANADA, 12-rowed. No. 1848 of 1884.

Six ears 8-rowed, 11 ears 10-rowed, 4 ears 12-rowed. Some ears Canada 12-rowed, No. 29: some ears Canada, No. 2; some ears Early Dutton, No. 31. Olive, black, red and brown flint kernels occur on all, and one 10-rowed ear has golden sweet kernels intermixed.

No. 85. GOLDEN DEW DROP. No. 1918 of 1884.

Twenty-four ears; the crop all Canada, No. 2, or Canada 12-rowed, No. 29, with many slate and darkish flint kernels. Not an ear like Golden Dew Drop, No. 7.

No. 89. PURPLE NEW ENGLAND 8-ROWED. No. 1866 of 1884.

Seven purple 8-rowed ears, 10 ears mostly yellow. The purple ears on type of seed used; the spotted ears resemble Canada, No. 2, with yellow and blackish flint and golden, purple and black sweet kernels; some ears Waushakum, No. 5, with a few brown and speckled and white flint kernels. Compare with No. 25 of this year.

No. 94. WHITE AND YELLOW FLINT KERNELS from No. 1826 of 1884.

Nineteen ears; some ears resemble New England Pop, No. 1, with some amber and black sweet kernels; some ears Canada, No. 2, with some amber and golden sweet kernels; some ears resemble New England eight-rowed, No. 21, with some amber, golden and black sweet kernels; some ears are Chinese Golden, No. 39, with some amber, golden and black sweet kernels; some ears resemble African E. 2, No. 1912 of 1884, with some amber, golden and black sweet kernels. Compare No. 43 sweet of this year.

No. 95. SANFORD. No. 1861 of 1884.

Twenty ears; a few Silver White Flint, No. 17; the most of the ears on type. A few yellow and slate flint kernels.

No. 97. CHINESE GOLDEN. No. 1849 of 1884.

Twenty-six ears, all on type, but much larger in ear and kernel than the seed sown, or our museum samples.

No. 100. GOLDEN FLINT KERNELS, from No. 1821 of 1884.

Twelve ears; some Chinese Golden, No. 39, with some golden and black sweet kernels; some resemble Canada, No. 2, but quite small, and with some sweet kernels; some resemble Canada 12-rowed, No. 29, with some sweet kernels. Compare No. 138 sweet of this year.

No. 104. YELLOW FLINT KERNELS from No. 1868 of 1884.

Twenty-four ears 8-rowed, 2 ears 10-rowed. Fifteen ears are decidedly Waushakum; seven ears are somewhat spotted, and resemble the Mandan, but with flint kernels; two ears not placed; two ears nubbins. Compare No. 93 dent of this year.

No. 105. YELLOW FLINT KERNELS from No. 1825 of 1884.

Fifteen ears. Some are Canada, No. 2, with some amber, golden and blackish sweet and white flint kernels; some ears 18 and 20-rowed White Pearl Pop, of rather large ear and kernel, with sweet kernels intermixed. Compare No. 128 sweet of this year.

No. 111. BLUE FLINT KERNELS from No. 1867 of 1884.

Twenty-three ears, some Canada, No. 2, others New England Eight-rowed, No. 21. Quite a number of sweet kernels on all the ears. Blue color predominating, but a great mixture. Compare Nos. 23 and 49 sweet of this year.

No. 115. WAUSHAKUM. No. 1865 of 1884.

Fourteen ears, all on type, one brownish flint kernel noted.

No. 123. WHITE FLINT KERNELS from No. 1889 of 1884.

Fifteen ears 8-rowed, 3 ears 6-rowed. The ears resemble closely Connecticut White Flint, No. 16, even to the capping at the tip; some pink, yellow and blue flint kernels.

No. 127. LAMSON'S YELLOW FLINT, Greg.

Eleven ears, all on type, which is a long (9–11 in.) Canada. A few blackish kernels.

No. 130. IMPROVED EARLY CANADA. No. 1854 of 1884.

Twenty-six ears. One ear Smedley Dent, No. 13; some ears Canada, No. 2; other ears New England Eight-rowed, No. 21, but darker golden.

No. 133. LONGFELLOW. No. 1857 of 1884.

Eighteen ears, all on type, an occasional discolored flint kernel.

No. 136. COMPTON from ———

Sixteen ears, all on type, a few brownish flint kernels.

DENT CORNS.

No. 2. CHESTER COUNTY MAMMOTH. No. 1877 of 1884.

One long red ear, twelve ears apparently on type. Too unripe for study. At edible maturity Sept. 10.

No. 11. RURAL UNION. No. 1883 of 1884.

Eighteen ears. Too unripe for study.

No. 15. DENT KERNELS from No. 1823 of 1884.

Twenty-five ears. Some ears resemble Forty Days Flint, No. 14, some yellow flint and sweet kernels. The remaining ears resemble the African forms of flint E. 1, No. 39, and the same in white kernels of Chinese Golden, No. 39. There are no dent ears or kernels in the crop. Compare No. 119 sweet of this year.

No. 24. YELLOW DENT KERNELS from No. 1871 of 1884.

Nineteen ears. Some ears Benton Dent, No. 1, with some golden and black sweet kernels; some ears Adams Early, No. 39, with some yellow dent and amber and white sweet kernels; one ear resembles Illinois Yellow, No. 19. Compare No. 88 sweet of this year.

No. 30. ADAMS EXTRA EARLY. Sta. 1884.

Seventeen ears, all on type; a few blue kernels.

No. 32. DENT KERNELS FROM SWEET EAR from No. 1839 of 1884.

Twenty-four ears. The ears in general shape like the unhusked Pod corn of 1883, but too unripe for study. Compare No. 145 sweet of this year.

No. 33. CHESTER COUNTY MAMMOTH. Sta. 1884.

Twenty-five ears, mostly appearing on type but too unripe for study. One ear is flint, resembling Sanford, No. 19, precisely, and not so unripe as the dents.

No. 45. MARYLAND WHITE GOURD SEED. No. 1881 of 1884.

Fourteen ears, very unripe, just edible Sept. 23.

No. 53. WHITE DENT KERNELS from No. 1827 of 1884.

Eighteen ears. Some resembling Chinese Golden flint, No. 39, in all but color, being white, and apparently No. 1912 of 1884, a few black and some white sweet kernels; some ears a coarse Egyptian Pop, with some sweet kernels; some ears a poorly bred Canada twelve-rowed, with sweet and white flint kernels intermixed. Compare No. 86 sweet of this year.

No. 54. DENT OR SOFT KERNELS from a podded sweet ear. No. 1842 of 1884.

Five pod ears, fourteen unpodded ears. The pod ears resemble in form the pod ears of 1883; twelve of the unpodded ears are precisely the unpodded ears or 1883. (See p. 41, Report of 1883;) two ears are of the form of Zuni Yellow soft, No. 7, but the kernels pink, and some pink tipped sweet kernels intermixed.

No. 60. ADAMS EARLY. No. 1873 of 1884.

Nineteen ears; some on type, with a few purple dent kernels; some Benton Dent, No. 1, with some slate colored dent kernels; some resemble Long Island Dent, No. 9, but the cob white. Compare No. 101 of this year.

No. 66. ORANGE PRIDE, Suffern.

Too unripe for study. Silked August 25.

No. 69. BENTON DENT. No. 1874 of 1884.

Sixteen ears on type, and two ears Waushakum flint, No. 5. Some blue and some dingy kernels on all the ears, but no flint kernels on the dent, nor dent on the flint ears. Compare No. 57 flint of this year.

No. 70. ORANGE PRIDE, Suffern.

Nineteen ears; too unripe for study; silked August 31.

No. 73. BENTON DENT. E. H. Beckwith, Dakota.

Eighteen ears, all on type; a few discolored dent kernels.

No. 93. YELLOW DENT KERNELS from a Smedley type ear, from No. 1868 of 1884.

Eight ears 8-rowed, ten ears 10-rowed, two ears 12-rowed. Some ears resemble Smedley, No. 13, even to the pink cob; some ears are Waushakum flint, No. 5, but a few white and dark flint kernels; a few ears close to Canada, No. 2, but I cannot place; a few ears Eight-rowed Brown flint, No. 12. Compare No. 104 flint of this year.

No. 101. ADAMS EARLY. No. 1873 of 1884.

Twelve ears on type, a few blackish dent kernels; of the remaining eight ears some are Benton Dent, No. 1, some Long Island Dent, No. 9, and some I cannot place. Some discolored kernels on all the ears. Compare No. 60 of this year.

No. 108. CHAMPION WHITE PEARL, Suffern.

Eighteen ears. Seventeen too unripe for study, being edible only on Sept. 22; one ear is Adams Early, with some blue kernels, but scarcely ripe.

No. 114. AFRICAN MAIZE, E 3. No. 1913 of 1884.

Twenty ears. Some resemble Chinese Golden flint, No. 39, and no off kernels; a few are Waushakum flint, No. 5, with a few discolored flint kernels; some resemble Benton Dent, No. 1, with a few brown and black dent kernels; one very unripe ear apparently like seed sown; one ear not placed, a flint, 10-rowed, yellow, with some white and slate flint, amber, golden and blackish sweet kernels.

No. 116. BLOUNTS PROLIFIC, 10-rowed. No. 1875 of 1884.

Twenty-six ears apparently on type, but very unripe. Two ears can be unhesitatingly referred to the unhusked pod corn type of 1882 and 1883: the kernels are very heavily glumed; very unripe.

No. 118. BENTON DENT. Van Thoman, Ct.

Thirteen ears, all on type, some discolored flint kernels.

No. 120. PRIDE OF THE WEST, Suffern.

Five ears, too unripe for study.

No. 134. SIBLEY'S PRIDE OF THE NORTH. No. 1884 of 1884.

Thirteen ears; some are Smedley, No. 13, others are on type. A few brown and white dent kernels.

No. 146. EVAN'S RED, Suffern.

Seven ears too unripe for study.

SOFT CORNS.

No. 1. TUSCARORA. No. 1892 of 1884.

Eighteen ears, all on type, some yellow, purple and reddish kernels. Quite unripe.

No. 5. COCOPA INDIAN. Dr. Palmer.

Fourteen ears, all on type, many colors.

No. 18. ZUNI PURPLE KERNELS from No. 1896 of 1884.

Eleven ears, all on type, some peculiar russet colored ears, and a few ears with some sweet kernels. Compare Nos. 35 and 87 of this year.

No. 21. COCOPA INDIAN. Dr. Palmer.

Twenty-five ears, all on type, many colors.

No. 26. RED RIVER, white kernels. No. 1890 of 1884.

Seventeen ears; many on type, but with a few yellow and black soft kernels; some resemble Mandan, the kernels mostly white, but some colored soft.

No. 35. ZUNI chocolate kernels from No. 1896 of 1884.

Six ears, some a beautiful glossy chocolate with a few white and blue soft kernels intermixed, all soft. Compare Nos. 18 and 87 of this year.

No. 37. ZUNI BLUE. No. 1894 of 1884.

Twenty-one ears, all on type; many colors to the kernels on some ears.

No. 47. WYANDOTTE. J. S. Case, Mo.

Too unripe for study; bloomed Sept. 16.

No. 48. ZUNI purple speckled kernels from No. 1898 of 1884.

Twelve ears, all on type; many colors.

No. 56. COCOPA INDIAN. Dr. Palmer.

Seventeen ears, all like seed planted; some ears very unripe.

No. 58. ZUNI white kernels, from 1897 of 1884.

Sixteen ears, all on type of Zuni Yellow, No. 7. Some ears pure white, others mixed colors. Compare No. 67 of this year.

No. 64. WYANDOTTE. Dept. of Agr.

Too unripe for study. Bloomed Sept. 16.

No. 67. ZUNI pink kernels white cob from No. 1897 of 1884.

Four pink ears, eight mixed ears, all on type. Compare No. 58 of this year.

No. 75. ZUNI yellow kernels from No. 1899 of 1884.

Fifteen ears, all on type of Zuni Yellow, No. 7. Compare No. 76 below.

No. 76. ZUNI yellow kernels distinctly indented from No. 1899 of 1884.

Eleven ears, mostly Zuni Yellow No. 7; some are Zuni Purple, No. 9 in all but color; one ear flint, resembling Canada No. 2, but slightly monstrous, a tassel protruding from the summit. Compare No. 75 above.

No. 87. ZUNI red kernels from No. 1896 of 1884.

Five purple ears, 3 red ears, 7 mixed ears. All on type of Zuni Purple, No. 9. Compare Nos. 18 and 35 of this year.

No. 107. OMAHA. Sibley & Co.

Nine ears reddish eight ears blue. all 8-rowed. Some ears flint kerneled and ripe; the majority on type, and unripe. The flint kerneled resemble Canada No. 2, but the color the peculiar red of the soft corns.

No. 109. ZUNI black kernels from No. 1895 of 1884.

Ten ears, all on type, no off kernels.

No. 110. BLUE KERNELS from No. 1902 of 1884.

Seventeen ears, all on type of Mandan, many colors.

POP CORNS.

No. 3. QUARANTINO. No. 1925 of 1884.

Twenty-three ears on type, four ears resemble New England 12-rowed Pop. A few brown flint kernels on the type ears, some white and blue flint kernels on the others.

No. 9. BEARS FOOT, Harris.

Thirteen ears, twelve of which are flattened strongly, one slightly. All on type. No off kernels.

No. 12. WHITE KERNELS FROM NEW ENGLAND POP EAR from No. 1930 of 1884.

Thirteen ears all on type of New England, No. 1; a few brownish flint kernels. Compare No. 22 of this year.

No. 13. WHITE PEARL 18-rowed from No. 1925 of 1884.

Eighteen ears, all White Pearl, but of white and red color, and two distinct varieties.

No. 20. SMALL WHITE PEARL. Sta.

Twenty-three ears, mostly on type of seed, but some Common 12-rowed, No. 3.

No. 22. NEW ENGLAND yellow from No. 1930 of 1884.

Twenty-four ears, some New England, No. 1, some Common 12-rowed, No. 3; some Rice pop very close to Egyptian, No. 9. A few discolored pop kernels on all. Compare No. 12 of this year.

No. 81. PURPLE RICE from No. 1926 of 1884.

Three yellow ears, Rice or Egyptian No. 9 type, with some purplish kernels; twenty ears purple Egyptian; one purple ear of the Red Pearl type.

No. 98. BEARS FOOT, Harris.

Three ears, all on type and flattened.

No. 112. BLUSH PEARL from No. 1927 of 1884.

Twenty-seven ears; all Pearl type, but some Small Pearl, No. 5½, others a more tapering ear and slightly larger. These latter have sweet kernels intermixed. Compare No. 122 of this year.

No. 117. WHITE RICE, Suffern.

Failed to germinate.

No. 122. RED PEARL from No. 1927 of 1884.

Ten red ears, twenty white ears, all Pearl Pop. The red ears are all on type and all of one color; the white ears are on type, but a few yellow and blush kernels. Curiously seven of the white and two of the red ears are fasciated like the Bears Foot, No. 10. Compare 112 of this year.

No. 420. LARGE KERNELS, COMMON 12-ROWED type. No. 1922 of 1884.

Twenty-four ears, some New England No. 1 yellow, others New England, No. 1, red, some Egyptian but without the spine.

No. 125. AMBER RICE Sta. 1884.

Nine ears Common twelve-rowed, No. 3; three ears a little rice kerneled, of Egyptian No. 9 form; no ears like the seed.

No. 129. AMBER RICE. No. 1929 of 1884.

Six Amber Rice ears, three red rice, three New England, No. 1, ears. All on type of their respective forms.

No. 131. WHITE RICE. No. 1916 of 1884.

Sixteen ears, all white, all Egyptian. Curiously seven of the ears are slightly flattened, reminding of Bears Foot, No. 10.

No. 142. BLACK. S. M. Babcock.

The seed used was as described in the 1881 Report. There were fifteen ears in the crop, not one like the seed, the ears being of the 8-rowed type, *i. e.*, cylindrical, kernels not rounding over but, ear stalk medium, kernels broader than deep. No off kernels.

No. 144. DWARF GOLDEN POP. Sta. 1884.

Seven ears, all on type, 1½ in. long.

Report of the First Assistant.*

WHEAT VARIETIES ; THEIR CHARACTERISTICS.

Notwithstanding the varieties of wheat are quite susceptible to variations brought about through the influence of climate, soil, and culture, or other means, there are certain specific features in the well pronounced varieties that insure, under ordinary conditions, their continuance in future generations. The so-called varieties of wheat are so numerous, and the confusion of names is so great that it seems desirable to reduce the multiplicity of names and to establish synonyms giving each true variety a proper place in a classification that might enable the agriculturist to determine the characteristics of the same. The task necessary to accomplish such a work, if it can be done at all, requires years of study and a familiarity with forms, varieties and species in all their details, as grown at home and abroad. As a result of work done at the Station, we are able to present descriptions of a number of varieties of wheat, which we place in the simplest kind of classification, as merely offering a convenient form for reference. The difference between the bearded and beardless is clearly distinguishable, likewise the white (or more properly speaking yellow) and bronze panicle. These two prominent features, color and form, will answer for such a classification as we at present wish to present. Synonyms are given in *italics*. All of the descriptions given are as taken in the field. Careful measurements were made, and counts taken on scores of plants of each variety. The descriptions are intended to apply to plants grown at the Station, and the source from which the seed was obtained, is noted in parenthesis, after each name. Ohio Ex. Sta. signifies Ohio Experiment Station ; Bradley refers to John Bradley, Lyons, N.Y.; Pat. Bro's. to Patterson Bro's., Windfall, Ind.; Eastman to W. L. Eastman, Ovid, N.Y., and Everitt to J. A. Everitt, Watsontown, Pa., to all of whom we wish to express our indebtedness for favors received. The averages given both in spikelets and grains, represent the numbers referred to as being far more common than any other, the others being the extremes. Though the number of grains per spikelet are usually three, very marked instances occur in varieties in which two or four strongly predominate. "Spring growth" refers to the condition of the plant prior to the development of the culm. The signs —, ‡, or + indicate whether the measurements tend to less, more or less, or slightly more than the figures given, — being minus sign, ‡ plus or minus, + plus. Though the color of straw is strictly yellow, the shades vary from a pure yellow to almost white, *i.e.*, yellowish white.

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*C. S. Plumb.

Bearded Wheats.

† *Panicles bronze.*

Golden Drop (Ohio Ex. Sta.), Syn.; *California Blue Stem* (Ohio Ex. Sta.); *Lancaster* (Ohio Ex. Sta.); *Red Amber* (Ohio Ex. Sta.); *Scott* (Ohio Ex. Sta.); *Tasmanian* (Ohio Ex. Sta.); *Tasmanian Red* (Pat. Bro's.)

Spring growth quite upright, plants vigorous. Straw yellow, very weak, of medium size, averaging in height three feet ten inches. Panicle light bronze, slightly loose, flattened, smooth, long bearded, averaging 3 — inches in length. Spikelets 10 to 16, averaging 13. Grains per spikelet 2 to 4, averaging three; dark amber, extra large, very slightly shrivelled, long; 1000 weighed 787 grains.

Mediterranean (Ohio Ex. Sta.)

Spring growth quite erect, vigorous, hardy. Straw yellowish-white, weak, of medium size averaging in height 3 feet 6 inches. Panicles smooth, long bearded, nearly square, not very compact, abruptly pointed, averaging in length 3 ‡ inches. Spikelets 11 to 16, averaging 13. Grains per spikelet 2–3, averaging 3 ; dark amber, large, long, contracted yet not shrunken; 1000 weighing 683 grains.

Mediterranean Hybrid (Eastman). Syn. : *Michigan Bronze* (Ohio Ex. Sta.)

Spring growth vigorous, erect, foliage profuse. Straw yellowish-white, of medium size, nearly upright, averaging in height 3 feet 6 inches. Panicles light bronze, smooth, long bearded, square, very compact, especially the upper portion which is usually much crowded, averaging in length 2½ ‡ inches. Spikelets 17 to 19, averaging 17. Grains per spikelet usually 3, of variable shades of amber, being both light and dark, short, plump, medium-sized; 1000 weighing 709 grains.

Smith's Improved (Ohio Ex. Sta.)

Spring growth semi-erect, sparingly foliaceous. Straw nearly erect, yellow, medium to large in size, averaging 3 feet 6 inches high. Panicles smooth, flat, loose, slightly tapering, medium to long bearded; average length of head 4 + inches. Spikelets per head 10 to 20, averaging 18. Grains per spikelet 2 to 4, averaging 3; light amber, medium to large, shrunken; 1000 weighing 602 grains.

Swamp (Ohio Ex. Sta.)

Growth medium, and erect. Straw yellow, rather beneath medium size, averaging in height 3 feet 6 inches. Panicles smooth, flattened, loose, slightly tapering, averaging 3½ ‡ inches; awns medium length. Spikelets per head 11 to 20, averaging 15. Grains per spikelet 2 to 3, averaging 2; dark amber, large, long, slightly shrunken; 1000 weighing 717 grains.

Velvet Chaff (Ohio Ex. Sta.)

Spring growth rather decumbent. Straw yellowish-white, weak, of medium size, averaging in height 3 feet 3 inches. Panicles of a dirty white or light bronze color, the glumes being covered with a silvery pubescence; form somewhat flattened, compact, slightly tapering, averaging in length 3 + inches. Spikelets average 17. Grains average 3 to a spikelet, are amber colored, large, usually plump; 1000 weighing 636 grains.

†† *Panicles white.*

Bennett (Ohio Ex. Sta.)

Spring growth wiry and lying close to the ground. Straw yellowish-white, medium sized, averaging in height 3 feet. Panicles smooth, flat, loose at base but very compact in the upper part, abruptly pointed. Spikelets per head 14 to 20, averaging 18. Grains to a spikelet 2 to 4, averaging 3.

Democrat (Ohio Ex. Sta.)

Spring growth nearly erect, vigorous. Straw yellow, of medium size, averaging 3 feet 10 inches in height. Panicles smooth, flattened, fairly compact, slightly tapering, averaging in length 3 + inches. Spikelets 13 to 18, averaging 16. Grains per spikelet average 3, light amber, often nearly white, medium size, plump, medium long; 1000 weighing 579 grains.

Imported Mediterranean (Ohio Ex. Sta.)

Spring growth very weak, and pale green in color, showing the effect of severe cold. Straw yellowish-white, very weak, under medium size, averaging in height 3 feet 3 inches. Panicles dark yellow, smooth, loose, nearly square, slightly tapering, averaging 2¾ ‡ inches in length; awns widely spreading. Spikelets per head 11 to 16, averaging 13. Grains per spikelet 2 to 3, averaging 2, very dark amber, long, shrunken; 1000 weighing 572 grains.

Mennonite (Pat. Bro's.)

Spring growth very poor, puny and grass-like. Straw yellow, erect, very small, averaging in height 2 feet 3 inches. Panicles smooth, nearly square, slightly tapering, loose, averaging 3 — inches in length. Spikelets 9 to 18, usually 14. Grains per spikelet 1 to 4, usually 2; color very dark amber, of medium size, much shrunken; 1000 weighing 533 grains. The poorest appearing variety tested in 1885.

Nigger (Ohio Ex. Sta.; Pat. Bro's.)

Spring growth vigorous, foliage profuse. Straw yellowish-white, under medium size, averaging in height 3 feet 6 inches. Panicles flattened, loose, somewhat tapering, averaging in length 3 ‡ inches. Spikelets 11 to 14, averaging 13. Grains per spikelet 2 to 3, averaging 3; dark amber, very large and long, slightly shrivelled; 1000 weighing 729 grains.

Theiss (Ohio Ex. Sta.) Syn.: *Egyptian* (Ohio Ex. Sta).

Spring growth decumbent. Straw yellow, weak, of less than medium size, averaging in height 3 feet 3 inches. Panicles smooth, flattened, loose, taper pointed, averaging in length 3 ‡ inches. Spikelets 2 to 18, averaging 14. Grains per spikelet 2 to 4, averaging 3; dark amber, medium to large, contracted though not shrunken but little, 1000 weighing 594 grains.

Treadwell (Ohio Ex. Sta.)

Spring growth semi-erect, and of medium vigor. Straw yellow, erect, medium to large, averaging in height 3 feet 6 inches. Panicles smoooth, flattened, rather compact, abruptly pointed, averaging in length 3¾ + inches. Spikelets 13 to 20, averaging 17. Grains per spikelet 2-4, usually 3; light amber, medium size, slightly shrunken, 1000 weighing 571 grains.

Valley (Ohio Ex. Sta.)

Spring growth erect and even. Straw yellow, nearly erect, of medium size, averaging in height 3 feet 6 inches. Panicles smooth, flattened, slightly loose, very little tapering, averaging in length 3¼ + inches; awns long. Spikelets 14 to 18, averaging 16. Grains per spikelet 3 to 4, averaging 4; dark amber, usually mottled, medium size,contracted though not shrunken, 1000 weighing 559 grains.

Wayne County Select (Ohio Ex. Sta.)

Spring growth very erect, even and robust. Straw yellow, erect, medium to large, averaging 3 feet 3 inches in height. Panicles smooth, long awned, very compact, square, abruptly pointed averaging 2¾ ‡ inches in length. Spikelets 15 to 20, averaging 16. Grains per spikelet 3 to 4, averaging 4; white, of medium size, plump, 1000 weighing 541 grains.

White Blue Stem (Ohio Ex. Sta.)

Spring growth semi-erect, medium stout. Straw yellow, nearly erect, small to medium, averaging in height 2 feet 10 inches. Panicles smooth, long awned in upper portion, flattened, compact to loose, slightly tapering, averaging 4 ‡ inches in length. Spikelets 14 to 19, averaging 17. Grains per spikelet 3 to 4, but almost invariably 4; dark amber, of medium size, slightly shrunken, 1000 weighing 586 grains.

White Velvet (Ohio Ex. Sta.)

Spring growth semi-erect, vigorous, abundantly foliaceous. Straw yellow, partly reclined, medium size, averaging in height 3 feet 3 inches. Glumes covered with a silky pubscence. Panicles fairly compact, flattened, slightly tapering, averaging 3¼ + inches. Spikelets 13 to 20, averaging 17. Grains per spikelet 2 to 4, averaging 3; medium or large, fairly plump, mottled amber, 1000 weighing 594 grains.

Beardless Wheats.

+ *Panicles Bronze.*

Clawson (Ohio Ex. Sta.) Syn.: *Royal Australian* (Ohio Ex. Sta.)

Spring growth strong and wiry. Straw yellow, rather weak, of medium size, averaging 3 feet 9 inches in height. Panicles smooth, rather loose, flattened, slightly tapering averaging in length 4 ‡ inches. Spikelets 14 to 18, averaging 15. Grains per spikelet usually 3; white, or mottled amber and white, of medium size, fairly plump, 1000 weighing 614 grains.

German Amber (Ohio Ex. Sta.)

Spring growth erect, and sparingly foliaceous. Straw yellow, weak, small to medium, averaging 3 feet in height. Panicles smooth, flattened, loose in the lower portion, but very compact toward the apex. Spikelets 13 to 19, averaging 16. Grains per spikelet 2 to 4, averaging 3; dark amber, long, slightly shrivelled, 1000 weighing 620 grains.

McGhee's Red (Ohio Ex. Sta.)

Spring growth vigorous, semi-erect. Straw yellowish-white, weak, of medium size, averaging 3 feet 3 inches in height. Panicles smooth, loose, rather than otherwise, square, slightly tapering, averaging 3¼ + inches in length. Spikelets 14 to 18, averaging 16. Grains per spikelet 2 to 3, averaging 3; very dark amber, or mottled amber and white of medium size, short, plump, 1000 weighing 614 grains.

McGhee's White (Ohio Ex. Sta.)

Spring growth of a paler green than McGhee's Red, small, semi-erect. Straw yellowish-white, weak, averaging in height 3 feet 3 inches. Panicles smooth, loose, square or flattened, very slightly tapering, averaging 3¼ + inches in length. Spikelets 12 to 17, usually 15. Grains per spikelet 2 to 3; white or very light amber, of medium size, short, plump, 1000 weighing 636 grains.

Michigan Amber (Ohio Ex. Sta.) Syn.: *Pool* (Ohio Ex. Sta.)

Spring growth vigorous, semi-erect. Straw yellowish-white, of medium size, averaging in height 3 feet 3 inches. Panicles smooth, square, neither loose nor compact, and but slightly tapering, averaging in length 3 ‡ inches. Spikelets 11 to 17, averaging 15. Grains per spikelet 2 to 3, averaging 3; dark amber or mottled amber and white, medium size, rarely plump, 1000 weighing 586 grains.

Red Fultz (Ohio Ex. Sta.)

Spring growth quite decumbent, vigorous, and sparingly foliaceous. Straw yellow, of medium size, averaging in height 3 feet 6 inches. Panicles smooth, flattened, loose, abruptly pointed, averaging 3 ‡ inches in length. Spikelets 13 to 17, averaging 15. Grains per spikelet 2 to 4, averaging 3, dark amber or mottled, of medium size, contracted though not shrunken, 1000 weighing 604 grains.

Sandomirka (Ohio Ex. Sta.)

Spring growth not strong, small, semi-erect. Straw yellowish-white, erect, of medium size, averaging in height 3 feet 4 inches. Panicles smooth, square or flattened, taper pointed, exhibiting great irregularity in length, averaging 3 ‡ inches long. Spikelets 12 to 21, averaging 16. Grains per spikelet 2 to 4, averaging 3; white, or mottled amber and white, plump, short, 1000 weighing 548 grains.

White Eldorado (Ohio Ex. Sta.)

Spring growth spindling and poor. Straw yellow, nearly erect, small to medium, averaging in height 2 feet 10 inches. Panicles smooth, flattened, loose, slightly tapering, averaging 4¼ + inches in length. Spikelets 14 to 20, averaging 17. Grains per spikelet 2 to 4, averaging 3; light amber, medium to large, shrunken, 1000 weighing 633 grains.

‡ ‡ *Panicles White.*

Champion Amber (Ohio Ex. Sta.)

Spring growth vigorous, robust, erect. Straw yellow, of medium size, averaging 3 feet 6 inches in height. Panicles smooth, rather loose, flattened, somewhat taper pointed, averaging 3½ + inches in length. Spikelets 16 to 22, averaging 17. Grains per spikelet almost invariably 3, dark amber, of good size, considerably shrivelled, 1000 weighing 502 grains.

Fultz (Ohio Ex. Sta.) Syn.: *Finley; Heighe's Prolific* (Ohio Ex. Sta.)

Spring growth good, well matted. Straw yellow, very weak, of medium size, averaging 3 feet 6 inches in height. Panicles smooth, fairly compact, slender, nearly square, taper pointed, averaging 3¼ ‡ inches in length. Spikelets 11 to 18, averaging 15. Grains per spikelet 2 to 4, and very variable; dark amber, small to medium, sparingly plump, 1000 weighing 509 grains.

Fultzo-Clawson (Bradley).

Spring growth backward, very decumbent, not stout. Straw yellow, erect, medium to large, averaging 3 feet 6 inches in height. Panicles smooth, flattened, very loose, and slightly tapering, averaging in length 4 + inches. Spikelets 13 to 18, averaging 16. Grains per spikelet almost invariably 2 with none of more than that number; extra dark amber, unusually large, long, somewhat shrivelled, 1000 weighing 810 grains.

Golden Straw (Ohio Ex. Sta.)

Spring growth poor, somewhat erect, undersized. Straw yellowish-white, erect, medium size, averaging 3 feet 3 inches in height. Panicles smooth, fairly compact, slender, nearly square, tapering, averaging in length 3‡ inches. Spikelets 12 to 18, averaging 16. Grains per spikelet 2 to 4, averaging 3; color amber, of medium size, short to medium, plump, 1000 weighing 509 grains.

Grecian (Ohio Ex. Sta.)

Spring growth semi-erect, sparingly foliaceous. Straw yellowish-white, of medium size, averaging in height 3 feet 3 inches. Panicles smooth, flattened, very loose in lower half, but more compact in the upper part, abruptly pointed, averaging 4 inches in length. Spikelets 15 to 21, averaging 18. Grains per spikelet 2 to 3, though nearly always 2, amber, medium to large, usually shrunken, 1000 weighing 606 grains.

Hungarian White Chaff (Ohio Ex. Sta.)

Spring growth poor to fair, erect. Straw yellowish-white, weak, small, plants averaging 3 feet in height. Panicles smooth, flattened, loose, taper pointed, averaging 3½‡ inches in length. Spikelets 13 to 20, averaging 17. Grains per spikelet 2 to 3, averaging 3 ; very clear dark amber, medium to large in size, slightly shrunken, 1000 weighing 645 grains.

Landreth (Ohio Ex. Sta.; Eastman.)

Spring growth good, partly erect, strong, producing an abundance of foliage. Straw yellowish-white, strong, erect, or nearly so, large, averaging in height 3 feet 10 inches. Panicles smooth, slightly loose, not real compact, flattened, abruptly pointed, averaging in length 4 inches. Spikelets 16 to 20, averaging 18. Grains per spikelet 2 to 4, averaging 3 ; white or slightly amber, of medium size, plump, 1000 weighing 564 grains.

Martin's Amber (Ohio Ex. Sta.; Everitt.)

Spring growth strong, semi-erect or close to surface of ground. Straw yellowish-white, very erect, stout, averaging 3 feet 6 inches in height. Panicles smooth, slightly loose, flattened, abruptly pointed, averaging 3½ + inches in length. Spikelets 15 to 20, averaging 18. Grains per spikelet 2 to 4, averaging 3 ; light amber color, of medium size, plump or shrivelled, 1000 weighing 529 grains.

Rice (Ohio Ex. Sta.) Syn.: *Early Rice* (Pat. Bros.)

Spring growth decumbent, moderately vigorous, with fairly profuse foliage. Straw yellow, nearly erect, of medium size, averaging in height 3 feet 6 inches. Panicles smooth, loose, slightly flattened, tapering, averaging in length 3¼‡ inches. Spikelets 12 to 19, averaging 16. Grains per spikelet 2 to 3, averaging 3, very dark amber, large, fairly plump, 1000 weighing 614 grains.

Rocky Mountain (Ohio Ex. Sta.)

Spring growth very stocky, form spreading, but foliage somewhat sparse. Straw yellow, of medium size, averaging 3 feet 4 inches in height. Panicles smooth, somewhat loose, nearly square, averaging 3¼ + inches in length. Spikelets 13 to 19, averaging 16. Grains per spikelet 2 to 4, averaging 3; very dark amber, of medium size, short, plump, 1000 weighing 590 grains.

Russian May (Ohio Ex. Sta.)

Spring growth small, semi-erect, with sparse foliage. Straw yellowish-white, erect or nearly so, beneath medium size, averaging in height 3 feet. Panicles smooth, square, compact, abruptly pointed, averaging in length 3¼ ‡ inches. Spikelets 14 to 21, averaging 17. Grains per spikelet 2 to 4, averaging 3; dark amber or mottled, under medium in size, shrivelled, 1000 weighing 409 grains.

Russian No. 2 (Ohio Ex. Sta.)

Spring growth semi-erect, very backward, and sparse in foliage. Straw yellowish-white, of medium size, averaging 3 feet in height. Panicles smooth, compact, square, abruptly pointed, averaging 3½‡ inches in length. Spikelets 11 to 20, averaging 17. Grains per spikelet 2 to 4, averaging 3, very dark amber, fairly plump, 1000 weighing 533 grains.

SILVER CHAFF (Ohio Ex. Sta.) Syn.: *Treadwell* (Ohio Ex. Sta.)

Spring growth semi-erect and good. Straw yellow, erect, medium to large, averaging 3 feet 6 inches in height. Panicles smooth, flattened, compact, slightly tapering, averaging in length 3¾ + inches. Spikelets 13 to 21, averaging 17. Grains per spikelet 2 to 4, averaging 3, amber color, medium to large, fairly plump, 1000 weighing 586 grains.

TRAVIS (Ohio Ex. Sta.)

Spring growth decumbent, backward. Straw yellow, erect or nearly so, medium to large, averaging in height 3 feet 3 inches. Panicles smooth, flattened, compact, abruptly pointed, averaging in length 4 — inches. Spikelets 17 to 22, averaging 20. Kernels per spikelet 2 to 4, averaging 3 ; dark amber or mottled amber and white, of medium size, plump, 1000 weighing 633 grains.

WASHINGTON GLASS (Ohio Ex. Sta.) Syn. : *Surprise* (Bradley).

Spring growth stout and decumbent. Straw yellow, erect or nearly so, of medium size, averaging in height 3 feet 3 inches. Panicles smooth, flattened, compact, abruptly pointed, averaging in length 3¾ + inches. Spikelets 16 to 21, averaging 19. Grains per spikelet 2 to 4, averaging 3 ; light amber with some white grains, very large, fairly plump, 1000 weighing 687 grains.

WHITE ROGERS (Ohio Ex. Sta.)

Spring growth very decumbent, vigorous, but not very foliaceous. Straw yellow, medium to large, averaging 3 feet 6 inches in height. Panicles smooth, flattened, slightly loose, taper pointed, averaging 3½ + inches. Spikelets 15 to 21, averaging 18. Grains per spikelet 2 to 4, averaging 3 ; dark amber, of medium size, plump, 1000 weighing 548 grains.

YORK WHITE CHAFF (Ohio Ex. Sta.)

Spring growth medium, semi-erect, with fairly abundant foliage. Straw yellow, erect, of medium size, averaging 3 feet 3 inches in height. Panicles smooth, flattened, slightly loose, and tapering but little, averaging in length 3¾‡ inches. Spikelets per head 15 to 21, averaging 18. Grains per spikelet 2 to 4, averaging 3 ; light amber or dark, being variable in color, medium to large, shrunken, 1000 grains weighing 625 grains.

ZIMMERMAN (Ohio Ex. Sta.) Syn,: *Scott*, (Ohio Ex. Sta.)

Spring growth rather decumbent, and weakly. Straw yellowish-white, erect, of medium size, averaging in height 3 feet 4 inches. Panicles smooth, ranging from compact to loose, flat to square, slightly tapering, averaging in length 3½ + inches. Spikelets 11 to 20, averaging 17. Grains per spikelet 2,to 4, averaging 3; dark amber, medium to large, fairly plump or slightly shrunken, 1000 weighing 701 grains.

No.	Variety.	Planted.	Vegetated.	Panicled.	Bloomed.	Matured.	Average Length of Panicle.	Color of Grain.	Size of Grain.	Weight of 1000 Grains.
1	Bennett	Sep. 23	Sep. 29	June 13	June 19	July 25				
2	Champion Amber	“ “	“ “	“ 9	“ 14	“ 19	3½ + in.	d. amber	Medium	502
3	Clawson	“ “	“ “	“ 8	“ 13	“ 18	4 ‡ “	white	“	614
4	Democrat	“ “	“ “	“ 9	“ 13	“ 18	3 + “	l. amber	“	579
5	Fultz	“ “	“ “	“ 7	“ 12	“ 16	3¼ ‡ “	d. amber	Med. to S.	509
6	Fultzo-Clawson	“ 25	Oct. 2	“ 7	“ 12	“ 20	4 + “	“	Large	810
7	German Amber	“ “	“ “	“ 7	“ 12	“ 20		“	Medium	620
8	Golden Drop	“ 23	Sep. 29	“ 9	“ 13	“ 19	3 — “	“	Large	787
9	Golden Straw	“ “	“ “	“ 7	“ 12	“ 17	3 ‡ “	amber	Medium	509
10	Grecian	“ 25	Oct. 2	“ 12	“ 15	“ 21	4 — “	“	Med. to Lge.	606
11	Hungarian White Chaff	“ “	“ “	“ 7	“ 13	“ 21	3½ ‡ “	d. amber	“	645
12	Imp't'd Mediterranean	“ 23	Sep. 29	“ 12	“ 14	“ 21	2¾ ‡ “	“	“	572
13	Landreth	“ “	“ “	“ 10	“ 14	“ 18	4 — “	white	Medium	564
14	Martin's Amber	“ “	“ “	“ 9	“ 13	“ 19	3½ + “	l. amber	“	529
15	McGhee's Red	“ “	“ “	“ 7	“ 12	“ 18	3¼ + “	d. amber	“	614
16	McGhee's White	“ “	“ “	“ 7	“ 13	“ 18	3¼ ‡ “	white	“	636
17	Mediterranean	“ “	“ “	“ 7	“ 13	“ 21	3 ‡ “	amber	Large	683
18	Mediterranean Hybrid.	“ “	“ “	“ 7	“ 13	“ 18	2½ ‡ “	various	Medium	709
19	Mennonite	“ 25	Oct. 2	“ 11	“ 14	“ 22	3 — “	d. amber	“	533
20	Michigan Amber	“ 23	Sep. 29	“ 7	“ 12	“ 18	3 ‡ “	“	“	586
21	Nigger	“ “	“ “	“ 7	“ 13	“ 17	3 ‡ “	“	Large	729
22	Red Fultz	“ “	“ “	“ 7	“ 13	“ 18	3 ‡ “	“	Medium	604
23	Rice	“ “	“ “	“ 7	“ 13	“ 18	3¼ ‡ “	“	Large	614
24	Rocky Mountain	“ “	“ “	“ 6	“ 12	“ 17	3¼ + “	“	Medium	590
25	Russian May	“ “	“ “	“ 6	“ 12	“ 17	3¼ ‡ “	“	Small	409
26	Russian No. 2	“ 25	Oct. 2	“ 7	“ 12	“ 20	3½ ‡ “	“	Medium	533
27	Sandomirka	“ 23	Sep. 29	“ 7	“ 13	“ 20	3 ‡ “	white	“	548
28	Silver Chaff	“ “	“ “	“ 7	“ 13	“ 20	4 + “	l. amber	“	586
29	Smith's Improved	“ 25	Oct. 2	“ 8	“ 14	“ 19	4 + “	“	Med. to Lge.	602
30	Swamp	“ “	“ “	“ 6	“ 12	“ 18	3½ ‡ “	d. amber	Large	717
31	Theiss	“ 23	Sep. 29	“ 7	“ 12	“ 19	3 ‡ “	“	Med. to Lge.	564
32	Travis	“ 25	Oct. 2	“ 8	“ 14	“ 21	4 — “	“	Medium	633
33	Treadwell	“ 23	Sep. 29	“ 7	“ 13	“ 20	3¾ + “	l. amber	“	571
34	Valley	“ “	“ “	“ 7	“ 13	“ 17	3¼ + “	d. amber	“	559
35	Velvet Chaff	“ “	“ “	“ 6	“ 12	“ 17	3 + “	amber	Large	636
36	Washington Glass	“ 25	Oct. 2	“ 10	“ 14	“ 22	3¾ + “	l. amber	“	687
37	Wayne County Select	“ 23	Sep. 29	“ 7	“ 13	“ 17	2¾ ‡ “	white	Medium	541
38	White Blue Stem	“ 25	Oct. 2	“ 9	“ 13	“ 18	4 ‡ “	d. amber	“	586
39	White Eldorado	“ “	“ “	“ 9	“ 14	“ 22	4¼ + “	l. amber	Med. to Lge,	633
40	White Rogers	“ 23	Sep. 29	“ 7	“ 13	“ 20	3½ + “	d. amber	Medium	548
41	White Velvet	“ “	“ “	“ 7	“ 12	“ 17	3¼ + “	various	Med. to Lge.	594
42	York White Chaff	“ “	“ “	“ 7	“ 12	“ 20	3¾ ‡ “	l. amber	“	625
43	Zimmerman	“ “	“ “	“ 7	“ 12	“ 20	3½ + “	d. amber	“	701

PLAT TEST OF VARIETIES OF WHEAT.

On Sept. 23 and 24, 1884, twenty-four one-twentieth acre plats were sown to wheat varieties. The ground was prepared by plowing, worked with disk and smoothing harrows, and fertilizer at the rate of 400 lbs. per acre, strewn broadcast, and harrowed in. The soil was clayey-loam, excepting one end of the field where the brow of a slight descent was of somewhat lighter character. Otherwise the conditions were about the same. Seed at the rate of a bushel and a peck per acre was applied in the drill, after the usual method of seeding in this vicinity.

On Oct. 14, 1884, two plats of one-twentieth acre each were planted in the same manner as the above, and in the same field, for the purpose of comparing the late with the early seeding. The varieties were Mediterranean Hybrid and Tasmanian Red.

All of the early planted varieties vegetated Sept. 29, no perceptible difference being noted in period of vegetating, and a constant growth was made until the ground became hardened by frost. With the late sown plats, there was much uncertainty for some time regarding the success of vegetating, owing to the prevalence of strolling poultry on the seed bed. However, in the course of two weeks a portion of the seed had vegetated, yet the comparison with the early sown plats cannot be considered a fair one, owing to the loss of seed devoured by poultry.

Below are given notes made upon each variety at different periods of growth, up to the time of harvesting. In the spring of 1885, the plats were carefully examined and the conditions of the varieties indicated by the following signs,— | meaning inferior condition, ‡ | medium, + | good, and | + | extra good. The dates of the observations precede the notes in each variety.

Bennett, Dec. 1, '84: Good. Plants robust, growing close to surface, and presenting a matted appearance. April 27, '85: + | Growth erect. July 16: straw erect but growth uneven.

Champion Amber, Dec. 1, '84: Good. Plants vigorous and growing close to surface. April 27, '85: + | Drills comparatively full; growth erect. July 17: Straw stout and but slightly inclined.

Clawson, Dec. 1, '84: Fair. Plants not extra vigorous. April 27, '85: ‡ | Easily smothered in depressions. Habit of growth spreading. July 17: Straw stout and but very little inclined.

Democrat, Dec. 1, '84: Good. Plants very vigorous. April 27, '85: ‡ | Conditions analogous to Clawson. July 16: Straw bright, erect of good quality.

Egyptian, Dec. 1, '84: Strong and healthy. April 27, '85, ‡ | . Majority of plants weakly, but plat well covered. July 17: Straw generally erect.

Finley, Dec. 1, '84: Strong and healthy. April 27, '85,— | . Many plants badly injured, and plat sparsely covered. Growth matted. July 15: Straw not very stout, bright, nearly erect.

Fultz, Dec. 1, '84; Growth medium, plants often inclined to be weakly. April 27, '85: — | . Many small weak plants. Badly injured. Habit of growth matted. July 17: Straw of poor growth, but erect.

Heighe's Prolific, Dec. 1, '84: Very good, strong growth. April 27, '85: + | . Plat covered with good growth, spreading. July 11, '85: Straw erect, fairly stout, rather whitish-yellow.

Landreth, Dec. 1, '84: Very good. Growth vigorous and stout. April 27, '85, + | . Plat fully covered, growth erect. July 17: Straw erect, and of good stout growth.

Martin's Amber, Dec. 1, '84: Very good. Plants very vigorous and strong. April 27, '85: + | . Plants but slightly injured. Growth matted. July 17: Straw very erect, bright, and of even growth.

Mediterranean, Dec. 1, '84: Good. Growth medium stout. April 27, '85: ‡ | . Holds its own well. Growth erect. July 15: Straw weak, of a maroon tint on upper portion, and though not lodged is inclined to one side. Heads very even in size.

Michigan Amber, Dec. 1, '84: Good. Growth stout and vigorous. April 27, '85: ‡ | . Plat fairly covered. Habit of growth flat. Plants fairly vigorous. July 15: Straw neither stout nor bright, and rather inclined; maroon tinted on upper portion.

Michigan Bronze, Dec. 1, '84: Good. Growth stout and vigorous. April 27, '85: + | . Growth strong, rather erect. But slightly injured by frost, and quite forward. July 15: Straw erect, of a maroon tint, and not at all bright.

Nigger, Dec. 1, '84: Fair. Plants small. April 27, '85: — | . Growth backward, weakly and rather low. July 16: Straw weak and reclining.

Pool, Dec. 1, '84: Good. Growth vigorous and strong. April 27, '85: + | . In good condition, and upright form. July 15: Straw erect, maroon tinted.

Red Fultz, Dec. 1, '84: Plants not very vigorous. April 27, '85: — | . Many small, weakly plants. Growth matted. Plants badly injured. July 16: Straw erect.

Rice, Dec. 1, '84: Fair. Plants medium stout in growth. April 27, '85: + | . Plat covered with a fairly good growth. Partly erect. July 15: Straw erect, bright, heads averaging about the same size.

Royal Australian, Dec. 1, '84: Good. Growth fair to medium. April 27, '85: ‡ | . Plants vigorous, but not stocky. Growth matted rather than erect. July 15: Straw not over medium stout, slightly inclined and fairly bright.

Russian May, Dec. 1, '84: Fair. Plants medium stout in growth. April 27, '85: ‡ | . Injured in spots. Growth erect. July 15: Straw erect, not very bright, and heads quite uneven in size.

Sandomirka, Dec. 1, '84: Fair. Growth not very stout. April 27, '85: — | . Plants weak and badly injured, appearing in very poor form. July 22: Straw fairly erect, not very stout nor bright.

Silver Chaff, Dec. 1, '84: Good. Growth strong and vigorous. April 27, '85: + | . But slightly injured by winter. Growth spreading to erect. July 16: Straw erect, bright.

Treadwell (bearded). Dec. 1, '84: Very good. Plants vigorous and strong, April 27, '85: — | . Badly injured by winter. Nearly all the plants weak and puny. July 22: Straw short, slender, erect. Heads very small. This variety was grown on the slight knoll, which perhaps accounts for its inferior qualities of growth.

Treadwell (smooth). Dec. 1, '84. Good. Growth vigorous. April 27, '85:— | . The plants in this plat present an even worse appearance than in the bearded variety. July 22: Ditto Treadwell (bearded).

Wayne County Select, Dec. 1, '84: Very good, appearing unusually strong and vigorous. April 27, '85: + | + The healthiest, evenest growing plat on the field. Growth very erect, but slightly spreading, and rather advanced. July 15: Straw very erect, bright. Heads small and very compact.

Mediterranean Hybrid (Late seeding). Made a very scanty growth in the fall of '84. But few plants came up at all, and they very late in the season, not developing over two leaves to the plant. April 27, '85: Condition poor, and slightly winter killed. Aug. 1. Straw very short, erect, and growth decidedly sparse.

Tasmanian Red (Late seeding). Planted on the slope, the seeds vegetated slowly, and no plants developed over two leaves. Growth exceedingly sparse. April 27, '85: Very weak and but few plants to be seen. Aug. 1. Straw very short, and but little to be seen.

It is to be noted that the results obtained from these plats have in themselves no fixed value. A number of the plats contained slight depressions in which accumulated water froze to a sufficient extent to smother the plants beneath, when the ground was too much frozen to admit of drainage. During the period of grain ripening, the plats suffered to a considerable extent from the depredations of English sparrows and crow blackbirds, which, in the early morning worked great havoc on some plats that were situated near by a wooded ravine. Heighe's Prolific in particular, as it stood in the shock was badly riddled. Considering these losses, which were unavoidable, and without taking into account the problematical value of plat experiments, these results should have no fixed value to the farmer as a guide in the choice of a variety.

Following are given the data of the appearance of the panicle, time of cutting, yield per plat in both grain and straw, and the estimated yield per acre of the same. The varieties were cut "in the dough," under conditions as closely alike as possible.

Variety.	Date of Panicling	Time of Cutting	Yield of Grain per plat	Yield of Grain per acre.	Yield of Straw per plat.	Yield of Straw ℔ acre.
Bennett	June 6	July 16	64 lbs. 8 ozs.	21 bush. 30 lbs.	82 lbs. 0 ozs	1640 lbs
Champion Amber	" 6	" 17	79 " 0 "	26 " 20 "	80 " 0 "	1600 "
Clawson	" 6	" 17	76 " 0 "	25 " 20 "	86 " 8 "	1730 "
Democrat	" 6	" 16	73 " 0 "	24 " 20 "	89 " 0 "	1780 "
Egyptian	" 6	" 17	81 " 8 "	27 " 10 "	86 " 0 "	1720 "
Finley	" 5	" 15	67 " 0 "	22 " 20 "	75 " 8 "	1510 "
Fultz	" 6	" 17	58 " 0 "	19 " 20 "	72 " 0 "	1440 "
Heighe's Prolific	" 4	" 11	82 " 0 "	27 " 20 "	99 " 0 "	1980 "
Landreth	" 6	" 17	71 " 0 "	23 " 40 "	96 " 0 "	1920 "
Martin's Amber	" 6	" 17	67 " 0 "	22 " 20 "	96 " 0 "	1920 "
Mediterranean	" 6	" 15	74 " 4 "	24 " 45 "	80 " 0 "	1600 "
Michigan Amber	" 6	" 15	67 " 8 "	22 " 30 "	82 " 0 "	1640 "
Michigan Bronze	" 6	" 15	61 " 0 "	20 " 20 "	76 " 0 "	1520 "
Nigger	" 6	" 16	47 " 8 "	15 " 50 "	53 " 8 "	1070 "
Pool	" 6	" 15	83 " 8 "	27 " 50 "	85 " 4 "	1755 "
Red Fultz	" 6	" 16	63 " 0 "	21 " 00 "	69 " 8 "	1390 "
Rice	" 6	" 15	70 " 0 "	23 " 20 "	86 " 0 "	1720 "
Royal Australian	" 6	" 15	76 " 8 "	25 " 30 "	86 " 0 "	1720 "
Russian May	" 6	" 15	62 " 8 "	20 " 50 "	82 " 0 "	1640 "
Sandomirka	" 6	" 22	50 " 0 "	16 " 40 "	60 " 0 "	1200 "
Silver Chaff	" 6	" 16	82 " 0 "	27 " 20 "	105 " 0 "	2100 "
Treadwell (bearded)	" 7	" 22	47 " 4 "	15 " 45 "	51 " 0 "	1020 "
Treadwell (smooth)	" 7	" 22	32 " 0 "	10 " 40 "	42 " 0 "	840 "
Wayne County Select	" 6	" 15	104 " 0 "	34 " 40 "	131 " 0 "	2620 "
Mediterranean Hybrid	" 12	Aug. 1	16 " 8 "	5 " 30 "	23 " 8 "	470 "
Tasmanian Red	" 15	" 1	7 " 12 "	2 " 35 "	8 " 12 "	175 "

DEPTH TESTS IN WHEAT PLANTING.

On Sept. 27 and 28, 1884, two small plats were specially prepared in which to test the vegetating powers of wheat planted at different depths. No fertilizer was applied. The soil was very carefully worked, and all stones and coarse lumps of earth removed. The surface was then leveled, and made as smooth as possible. In order to get different exposures, plat A was located upon the highest portion of the grounds where a wind-break protected from the north, but gave a good southern exposure. Plat B was located about 100 rods south of plat A and was sheltered on the south and south-westerly sides by a wooded ravine, and was fully exposed on the north and north-west sides ; the situation was rather lower down than that of plat A.

One hundred seeds for each depth were planted one inch apart in each row, in drills about six inches apart. An instrument upon which distances could be gauged, was employed to force the seeds at its point to the depths desired. In this way all errors in depth of planting were avoided. For 14 successive days the vegetations in each plat were counted, and ten and eleven days after the last recording, the plats were again carefully counted. The count in each row was verified. In some cases it may be noted in the table below that the number of plants vegetated exceeds the final total result. This is explained from the fact that the discrepancy was caused either by insects or animals eating off or in some way destroying the plants which made up the total.

A PLAT VEGETATIONS.

Depth Planted.	Sept. 30	Oct. 2	3	4	5	6	7	8	9	10	11	12	13	Total 24	May 15, 1885	Winter Killed.
¼ inch	62	27	0	0	0	0	0	0	0	0	1	0	0	88	1	87
½ "	16	72	0	0	2	0	0	0	0	0	0	1	0	91	31	60
¾ "		73	5	0	0	1	0	0	0	0	0	0	0	78	30	48
1 "		63	13	5	3	0	0	0	0	0	0	0	0	84	35	49
1½ "		40	33	5	3	2	0	0	0	0	0	0	0	80	64	16
2 "		22	44	6	5	2	1	0	0	0	2	0	0	80	59	21
2½ "			48	17	6	0	0	0	0	0	0	0	0	70	62	8
3 "			41	21	15	3	1	0	0	0	1	0	0	81	70	11
4 "				45	18	1	0	0	0	0	0	0	0	64	51	13
5 "					31	10	0	0	0	0	0	0	0	38	23	15
6 "					1	7	0	0	0	0	0	0	0	9	4	5
7 "				4	3	1	0	1	0	0	0	0	0	9	3	6

At the last observation taken in 1884, and the first in 1885, the following conditions were noted in A plat:

¼ inch. Oct. 24: Very vigorous, stooling close to the ground, but not erect. May 15: All the plants killed excepting one, and that poor and weakly.

½ inch. Oct. 24 : Stout and vigorous, little more erect than ¼ inch, but well branched. May 15: The major part of the plants killed, balance weak and sickly.

¾ inch. Oct. 24: Strong and vigorous, not quite as branching as in ¼ inch, and more erect. May 15: Most of the plants killed, balance weak and sickly.

1 inch. Oct. 24: Healthy, vigorous plants, but less branching and more erect than preceding. May 15: ditto ½ and ¾ inch.

1½ inch. Oct. 24: Stout and vigorous. Some parts of plant pale green in color. May 15 : ditto above.

2 inches. Oct. 24: Ditto 1 inch. May 15 : Ditto preceding.

2½ inches. Oct. 24: Growth of plants uneven, some strong and healthy, others small and weak. May 15: Growth not very vigorous.

3 inches. Oct. 24: Plants vigorous, though not so far advanced as 2½ inches. May 15: Ditto 2½ inches.

4 inches. Oct. 24: Very irregular in growth and size, foliage much longer than in ¼ and ½ inch depths, and more spindling in appearance. May 15: Ditto three preceding.

5 inches. Oct. 24: Plants weak, and in many cases only a part of a leaf appearing above ground. May 15 : Ditto preceding.

6 inches. Oct. 24 : Only a few spindling leaves to be seen. May 15: Plants backward.

7 inches. Oct. 24: Plants weak and feeble. May 15: Ditto 6 inches.

In this plat, the best results were received from the 2½ inch depth, the plants being stronger than any other depth, and suffering less from winter killing in proportion to vegetations, than the lesser or greater.

B PLAT VEGETATIONS.

Depth Planted.	Oct. 1	2	3	4	5	6	7	8	9	10	11	12	13	24	Total 25	May 15, 1885	Winter Killed
			3														
¼ in	40	45	19	1	6	0	0	1	0	0	0	0	0	0	97	91	6
½ "	10	59	36	0	2	0	0	2	0	0	0	0	0	0	91	87	4
¾ "		56	77	1	1	1	1	0	0	0	0	0	0	0	96	94	2
1 "		5	61	9	3	1	0	0	0	0	0	9	0	0	96	93	3
1½ "				31	2	0	0	0	0	0	0	0	0	1	95	93	2
2 "				62	24	0	0	0	0	0	0	1	0	0	87	82	5
2½ "				50	38	8	0	0	0	0	0	0	0	0	93	83	10
3 "				14	73	2	0	0	2	1	0	0	0	0	91	78	13
4 "					47	26	0	2	0	1	0	0	1	0	75	71	4
5 "					6	18	8	3	1	2	0	1	0	0	39	27	12
6 "					5	1	0	3	0	1	0	0	0	0	9	6	2
7 "					7	4	0	0	0	0	0	1	1	0	13	8	5

On Dec. 1, 1884, and May 15, 1885, the following conditions were noted in B plat:—

¼ inch. Dec. 1: Broadly spreading. The entire plant usually above the surface, even exposing the root. Dwarfish but vigorous. May 15: Strong and healthy.

½ inch. Dec. 1: Spreading. Roots not so frequently exposed. Vigorous. May 15: Ditto preceding. ¾, 1, 1½, 2, 2½, 3, 4 and 5 inches present no striking differences, all being stout and vigorous both at the beginning of winter and late in spring. The per centage of winter killing is small, as can be seen by referring to the above table. The 6 and 7 inch rows produced plants of a rather weakly growth in the fall, but by May 15 they had grown quite vigorous. At the period of bloom but little difference could be noted in the plants at the different depths, and in the abundance of heads. No harvest was made, owing to the destruction of the immature heads by English sparrows. As the plats were not well covered with snow but occasionally during the winter, they were more subject to winter-killing than they would have been had it been otherwise. Plat A was especially subject to occasional warm southern winds, and to all sunshine, hence the winter-killing can be easily accounted for. Plat B was protected from much sunshine and warm winds, by the wooded ravine, hence it was less subject to changes than A plat. Other things being equal, conclusions seem to substantiate the wisdom of planting our wheat at a depth of from one and one half to two inches, the fall results at these depths being most satisfactory, while the tendency to thrive during winter seems as well if not better adapted to these depths than to greater or lesser ones.

PLAT EXPERIMENTS WITH WHEAT.

Four plats of one-twentieth acre each were fitted for wheat in the usual manner. Fertilizer at the rate of 400 lbs. per acre was applied broadcast and harrowed in. The soil was clayey loam, and had not been under cultivation for some years previous, with the exception of F 16, which had been grown to corn in 1884 though no fertilizer had been applied. The following notes give the methods employed with results obtained from each plat.

Plat F 16. Planted Sept. 25, 1884, to Clawson wheat in drills 18 inches apart, the seed being placed at inch distances in the rows. Vegetated Oct. 1. It was hoed twice during the season of 1885, and was ripe on July 18. The plants did not stool very well, 18 heads being the largest number produced by any one plant. The panicles were usually long and loose, and in most cases produced 16 or 17 spikelets, and averaged strikingly longer than those from which the seed was produced. On July 24 the plat was cut. The yield was as follows: Straw 40 lbs. 4 ozs., grain 24 lbs. 12 ozs., or at the rate of 405 lbs. per acre of straw, and 8¾ bushels per acre of wheat. The object of the experiment was to see what results could be obtained by very thin seeding. The plat was fairly exposed on all sides, and notwithstanding the plants did well in the fall, they were badly winter-killed. The effect was favorable in size of grain and length of panicle, both being superior to those grown in our average wheat fields, but the result far from warrants adopting such a method as practical or profitable in this climate.

Plat F 17. Planted Sept. 25, 1884, to Clawson wheat after the ordinary method of seeding as employed in this vicinity, viz: by drill, in rows seven inches apart, about one and a half inches deep, and seeded at the rate of two bushels to the acre. Vegetated Sept. 30. Ripe July 20. The appearance of this plat late in fall was most excellent, and deteriorated in no manner all through the winter. During the growing season it appeared vigorous, and formed a large number of heads resembling in every way those commonly seen in fields of Clawson wheat, being noticeably shorter than those of plat F 16, though the seed sown was from the same source. 12 to 13 spikelets per head were most common, 15 or 16 being comparatively rare. Yield: Straw 128 lbs., grain 87 lbs. 4 ozs., or at the rate of 2560 lbs. straw per acre, and 29½ bushels grain per acre. Of the four plats planted, this gave the best yield, and in every way presented a superior appearance.

Plat F 18. Planted Sept. 25, 1884, to alternate rows of Clawson wheat and oats nine inches apart, the kernels of wheat being placed six inches apart in the row, and the oats thickly strewn. Both wheat and oats vegetated on Oct. 1, and grew well. The latter made a vigorous growth but was killed by excessive frost before having attained sufficient foliage to act as a mulch for the wheat, for which purpose it was intended. Though at the beginning of winter, the wheat appeared strong and vigorous, the severity of the weather was so great as to destroy all but a small portion of the plants. During the summer following the plat was hoed twice, and though the plants were few, as in F 16, the panicles and grains were much larger than in ordinary seeding. But 12 pounds of straw and 7 lbs. 8 ozs. of grain were harvested from the plat, or only a yield at the rate of 240 pounds of straw, and two and one-half bushels of grain per acre. The results gained from plats F 16 and F 18 seemed to demonstrate that the small quantity of seed applied brought about the increase in length of panicle and size of grain, although detrimental to crop.

Plat F 19. Planted to Clawson wheat Sept. 25, 1884, in the same manner as F 17. Vegetated Oct. 1, and made a vigorous, healthy growth, like its duplicate, F 17, till winter set in. December 23, a light covering of straw, as a mulch, was applied and left upon the plat till growth began in spring when it was removed. The plants had a paler, more sickly appearance than those of F 17, and many seemed to have died during the winter, probably from suffocation. The appearance of the plant was inferior up to ripening, July 23, owing to its having been so much retarded in growth. The panicles averaged longer than those of F 17, but shorter than F 16 and F 18, while the number of breasts per head averaged 15. Cut July 24, the yield in straw was 86 pounds 8 ozs., and in grain 44 pounds 8 ozs., or at the rate of 1730 pounds of straw and 13⅓ bushels of grain per acre.

SMUT EXPERIMENTS WITH OATS.

In an effort to determine what influence the character of the seed had upon the progeny, five rows of White Australian, and the same number of rows of Race Horse oats were planted. It is to be noted that the first mentioned variety in our 1884 test, smutted very badly, while the Race Horse did not smut at all. The names have no bearing in the matter, as they are synonyms, the main point being that no smut was apparent in one seed, while in the other it was very manifest. The rows were 33 feet long. Nothing more was done than to plant, and when the seeds were in the dough make a record from each series of rows, as follows:—

Row.		Variety.	Panicles in row.	Smutted panicles.	Per cent. of smut.
Series I.	1	White Australian	511	55	10.70
	2	" "	623	36	5.77
	3	" "	553	44	7.96
	4	" "	689	57	8.27
	5	" "	849	102	12.01
Series II.	1	Race Horse	792	10	1.26
	2	" "	629	15	2.38
	3	" "	499	8	1.60
	4	" "	660	15	2.27
	5	" "	572	10	1 74

A summary of the figures from each series, gives for Series I a total of 3225 panicles, of which 294 or 9.11 per cent. were smutty. Series II gives a total of 3152 panicles, of which 58 or 1.20 per cent. were smutty. Did the character of the seed used influence the percentage of smut ? is a potent question. The figures in themselves are full of interest, as seemingly answering the above, in the affirmative, yet with our very limited knowledge of the cereal smuts, we have not sufficient evidence to warrant arriving at such a conclusion.

Three rows thirty-three feet long, were planted to Race Horse oats. The grains were placed about an inch apart in the rows. From a very smutty lot of oats were collected grains of oats that were nothing but masses of smut. In row one, by the side of each healthy grain, was placed a grain of smut; in row two the number of grains of smut were increased to two, and in row three, four grains of smut surrounded each grain of oat. When the panicles had sufficiently developed, all were counted, after which the smutty panicles were counted. The following figures give the number of healthy panicles, smutty ones, and per centage of smut with each row:

Row 1.	One grain oat + one grain of smut.	Panicles 632	Smut 13	Per ct. of smut 2.05
Row 2.	" " + two " "	" 644	" 17	" " 2.63
Row 3.	" " + four " "	" 554	" 16	" " 2.88

Though the above figures show a clear per centage of gain, yet a comparatively slight one, such as will not warrant, in our estimation, the arriving at definite conclusions.

In order to note the effect of so called preventives of smut, two different solutions were made, in which White Australian oats that had smutted badly the previous year, were soaked. The first was a strong solution of water and copperas. The second a nitrate of potash solution, which consisted of one ounce of nitrate dissolved in one and one half pint of boiling water. The oats were soaked in separate lots in these solutions for about five minutes. They were then taken out and dried in plaster. Four rows of each were planted, with the following results:

Row.		Solution.	No. of Panicles	Smutty Panicles.	Per cent. of smut.
Series I.	1	Nitrate of Potash ----	975	61	6.25
	2	" " ----	833	56	6.72
	3	" " ----	725	88	12.13
	4	" " ----	986	48	4.86
Series II.	1	Copperas ------------	765	52	6.79
	2	" ------------	781	45	5.76
	3	" ------------	903	53	5.86
	4	" ------------	792	40	5.05

Summing up each, we find Series I produced 3519 panicles, of which 253 or 7.18 per cent. were smutty, while Series II produced 3241 panicles, 190 or 5.86 per cent. being smutty. The value of these figures, if they have any, may perhaps be questioned considering the short duration the oats were soaked in their respective solutions. However, it is noticeable that a considerably smaller per centage of these oats were troubled with smut than were the White Australian in Series I of the first recorded experiment, though the seed all came from the same source.

Experiments in Selection of Oats.

In the specimens of oats received at the Station designated as black, it has been noticed that the intensity of the black color was weak rather than strong. There were black, dun and nearly white oats to make up the quantity, and no matter what the variety, the color appeared about the same. Desiring to learn if the matter of color could be regulated by selection, the following experiment was tried, two different varieties of black oats being used, viz.: Black Champion and Black Tartarian.

From each variety of the crop of 1884 was carefully selected a quantity of the whitest, as well as of the blackest seeds to be found, each color being kept separate. It is to be noted that the seeds called black, were a dense dun-black, rather than black.

BLACK CHAMPION. Four rows thirty-three feet long were planted to selected white seed, and an equal number of rows, of the same length to selected black seed. As the plants stooled in early summer, a difference between the two sets of rows began to be manifest, the plants from the white seed being apparently more vigorous, healthy and larger than those from the black seed. As the development of the culm began, a change was brought about, by the plants from black seed increasing in vigor and finally excelling the others, so that just before ripening, it was noted that those from black seed were finer appearing plants than from the white, presented a more even growth, and were all open panicled. The selected white seed plants were a mixture of open and side head panicles, with a shorter growth than the others. A very close examination of the seeds from both selections was made. Those from the white were all apparently of that color, as in common oats and would appear as such to a careless observer, but nevertheless here and there was to be found a comparatively black or dun seed. From the black seeding resulted a mixture of dun and black oats, fairly representing the seed planted. A white grain was very uncommon. Apparently the seeds no more than preserved their individuality in the progeny, though the inclination was to increase of intensity of color.

BLACK TARTARIAN. Five rows each thirty-three feet long, were planted with selected black, and an equal number of rows from selected white seed.

The plants grown from selected black, Black Tartarian seeds, were much more vigorous early in the season than those from white seed, the difference in robustness and forwardness of growth being most remarkable. This condition was maintained through to blooming, and the plants from black seed matured some days earlier than did the others. All the panicles from black seed were of the "side head" formation, as should be with this variety of oats, but with the white, the open panicle was quite common. The evenness of growth of black was striking, while the whites were in most irregular form.

The difference in the resulting seeds from this variety is not so marked as with the Black Champion. From the black seeding was obtained a quantity of seed of the burnt or black brown color of the parent-stock, not noticeably differing from it. The white seeding produced seeds of a black-brown hue, not being strikingly lighter than the blacks, and somewhat approximating to them, but containing a few white seeds, thereby differing from the results of the black seeding which produced no white.

IMPROVEMENT IN SELECTING.

From a quantity of Chinese Hulless oats were selected enough small and large plump superior grains to plant an equal area. The large seed made the earliest growth, started the best, and presented a better appearance from first to last than did the plants from the small seed. This superiority was manifest in every particular all through the season. After thrashing, 10,000 grains of each selection were counted and weighed in individual thousands, with the following results, viz.:

Progeny small seed planted.		
1000 grains weighed	197.52	grains.
“ “ “	200.61	“
“ “ “	197.52	“
“ “ “	199.06	“
“ “ “	188.26	“
“ “ “	186.72	“
“ “ “	188.26	“
“ “ “	189.81	“
“ “ “	185.18	“
“ “ “	188.26	“
Average	192.09	

Progeny large seed planted.		
1000 grains weighed	211.41	grains.
“ “ “	212.95	“
“ “ “	208.31	“
“ “ “	212.95	“
“ “ “	211.41	“
“ “ “	219.12	“
“ “ “	208.31	“
“ “ “	206.75	“
“ “ “	211.41	“
“ “ “	211.41	“
Average	211.40	

The 10,000 seeds from the selection of small, weighed 5.5 ounces, the large 5.06 ounces. Estimating a bushel of hulless oats at fifty lbs. it would contain 800 ounces or one bushel of seed as estimated from the small selection, and would contain 266,600 more grains than a bushel of grain grown from the large seed. With this difference in number of grains for one bushel, taking 40 bushels for a yield of one acre, it would show a plurality of 10,664,000 small grains, no inconsiderable amount in number, weight or quantity.

Testing Oats for Synonyms.

In studying varieties of barley and oats during the season of 1884, whenever evidence was obtained warranting such a move, they were placed under the list of synonyms. The evidence from many varieties was questionable. In order to aid in comparing varieties, the following method was employed, viz.: When strong evidence gave reason for thinking two or more names were one and the same variety, the separate seed from the 1884 crop under these names, was carefully mixed together and planted in the spring. The growth of the resulting plants was carefully noted at all periods till harvest, and the grain then carefully examined. This method was only adopted as an aid to comparing varieties as grown side by side. Each of the following paragraphs refers only to an attempt to reduce to one variety. An equal quantity of the seed of each was mixed together.

White Australian, White Belgian, Welcome. Fifteen rows, each two rods long, were sown 18 inches apart. The seed of each name appeared alike, and all through the season no difference could be noted in growth, panicling, maturity, seed, etc. Last season's work led us to believe the three alike, and the work of the season of 1885 only strengthens that belief, and we class them all as White Australian.

White Australian, White Belgian, Welcome, New Australian, Race Horse. To the three first named were added New Australian and Race Horse as synonyms, and six rows planted as above. No difference to be distinguished from vegetation to harvest, and seeds apparently synonymous. In the report for 1884, Race Horse was given as a synonym of New Australian, No. 14 in the classification of oats. Sufficient evidence at this date warrants the removal of this name from the classification, it being none other than White Australian.

Probsteier and *White Probsteier*. Ten rows were planted. Though placed as separate varieties in the classification, two seasons' work convinces us that these names mean the same thing. The word "white" is very frequently prefixed to white varieties as an indication of color. It was the Probsteier that was first introduced, but at present seeds of Probsteier and White Probsteier oats are on sale in the market.

White Zealand and *White Novelty*. Ten rows of mixed seed were planted. Vegetation, panicling, maturity and seed indicate synonymy.

White Novelty, White Russian and *White Zealand*. The growth of 1884 produced very strong testimony as to the synonymy of the three above named, yet not sufficient to warrant reducing to one. The present season's study and comparison has given satisfactory evidence that White Novelty, White Russion and White Zealand are all one and the same variety. Ten rows of seeding gave identical results from beginning to end of season. Considering that the name White Russian is widely known, it is thought best to accept this as the standard, with the other two names for synonyms.

Chinese Hulless, Pringle's Excelsior and *Pringle's Hybridized Hulless*. The two last named were classed as synonymous in 1884, and farther study only serves to convince that the three above named do not essentially differ in any one respect, hence Pringle's Excelsior and Hybridized have been classed as synonyms of Chinese Hulless.

SORGHUM VARIETY TESTS.

How well is sorghum adapted to this latitude? is a potent question to the farmer. The past season a number of varieties were grown, and conditions noted, with the purpose in view of gathering evidence towards answering this question. One season's work will not give positive results that may be considered as furnishing data and establishing conclusions of sufficient importance to serve as a future guide. The growing season of 1885 was favorable in one respect yet unfavorable in another. An unusual amount of rainfall was somewhere injurious to the best results to be obtained from sorghum, while a late, warm fall was conducive to the maturing of this crop. The notes taken on the following varieties, have a direct, practical bearing upon the advisability of applying them to economic purposes on the farm. It is to be noted, that notwithstanding the tardiness of our frosts, most of the varieties demanded a longer or warmer season in which to mature, than this year's climatic conditions would allow.

AFRICAN WHEAT SORGHUM (Sibley). Planted May 23. Vegetated June 1. Panicled Sept. 19. Bloomed Sept. 30. Average height 6½ feet. Culms medium to small. Panicles open, erect. Plants backward, seed not being nearly ripe. Foliage light green.

AMBER (Thorb.) Syn.: *Amber Sugar Cane* (Thorb.). *Early Amber Sugar Cane* (Batchelor); *Early Amber Cane* (Sib.) Planted May 23. Vegetated May 31. Panicled Aug. 20. Bloomed Aug, 27. Average height 8½ feet. Culms medium to small. Panicles linear-lanceolate, very erect, slightly open. Foliage dark green. Seeds brown-black, ripe. This variety ripened sufficiently for sugar prior to frost. A test for sugar gave 12.16 per cent. cane sugar.

CHINESE (Thorb.) Syn.: *Chinese Sugar Cane* (Thorb.) Planted May 23. Vegetated May 31. Panicled Aug. 20. Bloomed Aug. 25. Average height 9 feet. Culms slender. Panicles ovate, 8 to 10 inches in length, 3 to 4 inches in diameter, erect, slightly open. Foliage dark green. Seeds brown-black when ripe, though but few reached this stage.

CHINESE HYBRID (Thorb.). Planted May 23. Vegetated May 31. Panicled July 27. Bloomed Aug. 1. Fit to cut Aug. 26. Average height 7 feet. Culms small and slender. Panicles open, erect. Foliage dark green. Seed brown-black. This variety is exceedingly grass like in form, being very small and remarkably early as compared with others. For a sugar plant however, it has no special value, a polariscope determination giving only 2.84 per cent. sugar.

DHOURA CANE (Sibley) Syn.: *Egyptian Rice* (Sibley) *Millo Maize* (Pratt). *Guinea Corn* (Dept. Agrl). *White seeded* (Dept of Agrl.) Planted May 23. Vegetated June 2. Panicled Aug. 24. Bloomed Sept. 5. Average height 6½ feet. Culms large. Foliage light green. Panicles compact, drooping over. Seed in the milk stage.

EARLY ORANGE (Thorb.). Planted May 23. Vegetated May 31. Panicled Aug. 25. Bloomed Aug. 31. Average height 9 feet. Culms stout. Foliage dark green. Panicles erect and somewhat compressed. Seed in the milk stage. Plants not ripe and usually very backward.

HONDURAS (Thorb.). Planted May 23. Vegetated May 31. Panicled Sept. 23. Bloomed Sept. 30. Average height 9 feet. Culms large. Foliage very light green, profuse. Panicles erect, mostly in bloom on Oct. 23, but not to milk stage.

INDIA (Collier). Planted May 23. Vegetated June 2. Panicled Aug. 25. Bloomed Aug. 31. Average height 8½ feet. Culms medium to large. Foliage dark green. Panicles erect, branching. Seed in the milk stage.

MILLER (Dept. of Ag'l). Planted May 23. Vegetated May 31. Panicled Aug. 25. Bloomed Aug. 27. Average height 8½ feet. Culms of medium size. Foliage dark green. Panicles erect, open. Seed brown and quite ripe. Oct. 24 ripe enough for cutting.

NEEAZANA (Dept. of Ag'l). Planted May 23. Vegetated May 31. Average height 7½ feet. Culms small to medium. Foliage light green. Panicles erect, slightly open. This variety was in bloom Oct. 24, but did not develop seed at all.

RED IMPHEE (Thorb.). Planted May 23. Vegetated June 1. Panicled Sept. 17. Bloomed Sept. 23. Average height 8 feet. Culms of medium size. Foliage profuse, dark green. Panicles compact, erect. Seed did not attain the milk stage.

RURAL BRANCHING (Thorb.). Planted May 23. Vegetated June 1. Oct. 24 panicles just peeping from the leaf sheaths. Average height 5½ feet. Culms small, very foliaceous. Foliage light green. This variety is of no use for sugar, as the growth is more to foliage than cane, and it is the latest variety tested at the Station.

STEWART'S HYBRID (Thorb.). Planted May 23. Vegetated May 31. Panicled Aug. 17. Bloomed Aug. 25. Average height 9 feet. Culms large. Foliage dark green. Panicles erect, open, spreading. Seed in the milk stage.

WHITE MAMMOTH (Dept. of Ag'l). Planted May 23. Vegetated May 31. Panicled Sept. 19. Bloomed Sept. 30. Average height 8 feet. Culms large. Foliage dark green. Panicles had not reached the milk stage by Oct. 24.

No.	Varieties of Sorghum.	Planted.	Vegetated.	Panicled.	Bloomed	Average Height	Size of Culm.	Condition of growth by Oct. 24.
1	African Wheat	May 23.	June 1	Sept. 19	Sept. 30	6½ ft.	Med. to sm.	Very late
2	Amber	"	May 31	Aug. 20	Aug. 27	8½ "	" "	Fully ripe
3	Chinese	"	"	"	Aug. 25	9 "	Slender	Late
4	Chinese Hybrid	"	"	July 27	Aug. 1	7 "	Very small	Very early
5	Dhoura Cane	"	June 2	Aug. 24	Sept. 5	6½ "	Large	Late
6	Early Orange	"	May 31	Aug. 25	Aug. 31	9 "	Stout	Very late
7	Honduras	"	"	Sept. 23	Sept. 30	9 "	Large	Very late
8	India	"	June 2	Aug. 25	Aug. 31	8½ "	Med. to lge.	Late
9	Miller	"	May 31	"	Aug. 27	8½ "	Medium	Ripe
10	Neeazana	"	"	--------	--------	7½ "	Small to m.	Very late
11	Red Imphee	"	June 1	Sept. 17	Sept. 23	8 "	Medium	Very late
12	Rural Branching	"	"	Oct. 24	--------	5½ "	Small	Very late
13	Stewart's Hybrid	"	May 31	Aug. 17	Aug. 25	9 "	Large	Late
14	White Mammoth	"	"	Sept. 19	Sept. 30	8 "	Large	Very late

Report of the Horticulturist.*

INTRODUCTION.

Our work during the past season has not differed in kind from that undertaken in 1883 and 1884. As usual, an important feature has been the testing of varieties in the garden, and the determination of synonyms. The peculiar nature of this work makes it difficult or impossible to hasten it to a conclusion. In endeavoring to make strictly accurate and complete descriptions, we can only find the characters which are constant by carefully comparing the notes of different seasons. We are also every year receiving new varieties, which we must compare with all those previously grown, in order to ascertain whether or not they are synonyms. In cases of doubt, our only recourse is to grow the suspected synonyms side by side the following season.

Our list of varieties, of which we have carefully made and verified the descriptions, is increasing each year, and in this report we publish our work upon the garden lettuce, as we did last year upon the pea. We now hope that the time is not far distant when we shall be able to present equally careful and complete descriptions of all the vegetables that thrive in our climate.

As in former years, we have performed such experiments in the horticultural field as have come to our mind, were within our means, and promised valuable results. The records of these are given in their appropriate places. The work of washing out roots, which we carried to a considerable extent in 1884, has the past season been placed in charge of the assistant horticulturist, who makes a special report on this subject.

As will appear in the notes of the fruit department, our list of small fruits has been increased by the addition of many new varieties.

The season, though cold and backward in spring, has on the whole been quite favorable to the development of our garden crops; particularly to those that do best in a moist and moderately warm climate. The plants of the cabbage family, for example, flourished unusually well. The egg-plant and pepper, however, which require a hot climate, were but a partial success.

With a few exceptions, our crops were unusually free from damage by destructive insects.

We have omitted in this report to note the date and percentage of vegetation, although such were recorded as usual.

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*E. S. Goff.

EXPLANATION OF ABBREVIATIONS.

We have used the following abbreviations of the names of seedsmen, and of works upon gardening to which we have had more or less frequent occasion to refer.

An abbreviation of the name of a seedsman, attached to a variety with a date, indicates that the seed was obtained from that source, in the year specified, and under the name to which the abbreviation is appended. If the abbreviation is of the author or name of a book, it indicates that the names to which it is appended was taken from the author or book named:

Batch.—D. Batchelor, Utica, N. Y.
Ben.—Ernst Benary, Erfurt, Germany.
Bl. or Bliss.—B. K. Bliss & Sons, New York.
Brill.—Farm Gardening and Seed Growing, by Francis Brill, 1872.
Browne.—D. J. Browne, Patent Office Report, 1854.
Burr.—Field and Garden Vegetables of America, by Fearing Burr, Jr., 1863.
Carter.—Carter & Co., London, Eng.
Chis. Trial.—Chiswick Trial, Gardener's Chronicle, 1868.
Dam.—Damman & Co., Portici, Italy.
Dybowski.—Traité de culture potagère, by J. D. Dybowski [1885].
Everitt.—J. A. Everitt & Co., Watsontown, Pa.
Farquhar.—R. & J. Farquhar & Co., Boston, Mass.
Fessenden.—New American Gardener, 1828.
Harris.—Joseph Harris Seed Co., Rochester, N. Y.
Hend.—Peter Henderson & Co., New York, or Gardening for Profit, by P. Henderson, 1867.
Hort. Soc.—London Horticultural Society, Gardeners' Chronicle, 1860.
Hort. Fran.—Horticulteur Francaise, 1824.
Hovey.—Hovey & Co., Boston, Mass.
Howcroft.—Howcroft & Watkins, London, Eng.
Land.—D. Landreth & Sons, Philadelphia, Pa.
Les pl. pot.—Les plantes potagères, by Vilmorin, Andrieux et Cie, 1882.
L'Hort. Fran.—L'Horticulteur Francaise, 1824.
Nellis.—A. C. Nellis & Co., Canajoharie, N. Y.
Noisette.—Manuel du jardinier, 1828.
Petit.—Nouveau Dictionaire du jardin, 1826.
Sib.—Hiram Sibley & Co., Rochester, N. Y.
Till.—L. F. Tillinghast, LaPlume, Pa.
Thomp.—R. T. Thompson, Gardeners' Chronicle, 1850 and 1860.
Thor. or Thorb.—J. M. Thorburn & Co., New York.
Vick.—James Vick, Rochester, N. Y.
*Vil.—Vilmorin, Andrieux et Cie, Paris, France.

"Fr." is used as an abbreviation for French; "Ger." for German, and "Hol." for Holland.

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*The names to which this abbreviation is applied have been taken from "Les plantes potagères," 1882, or the "Album de Clichés," 1883, by Vilmorin, Andrieux et Cie, or from seed packages obtained from this house.

Pre. or Prior prefixed to a date in any of the tables means that the fact there noted should have been noted previous to that date.

In the varieties received from Messrs. Vilmorin, Andrieux et Cie, the past season, we have been careful to preserve both the French and English names, when both were given on the packages. In all such cases we give the English name first, and append in parenthesis the French name.

BEET.

We tested the following list of beets and mangels, planting the seeds April 23 and 24, in rows twelve feet long and twenty-one inches apart, one row to each name. The soil received a liberal dressing of well rotted stable manure in the fall of 1884, which was plowed in as soon as applied. In the spring previous to planting, the soil was cultivated but not plowed. The ground was kept free from weeds, and the plants were thinned to six inches apart in the rows.

The date when the roots of each row were of edible size, and the number and average weight of the roots harvested were as follows:

Beets.	Of edible size	Days from planting	Number of roots.	Av. weight in ozs.
Crosby's Early Egyptian	June 26	64	40	14
Crown Prince	July 6	74	27	17
Dark Red Egyptian Turnip	June 30	68	38	14
Dewing's Extra Early Turnip	June 29	67	28	14
Dewing's Improved Blood Turnip	June 30	68	28	18
Early Bassano	July 1	69	27	19
Early Blood Turnip	July 6	74	26	18
Eclipse Turnip (Greg.)	June 26	64	29	16
Eclipse Turnip (Hen.)	June 26	64	21	29
Egyptian (Howcroft)	June 23	60	7	24
Egyptian (Greg.)	June 26	64	28	15
Golden Tankard	July 3	71	27	30
Half Long Blood	July 6	74	24	13
Hatch's Blood Turnip	June 29	67	11	24
Landreth's Very Early Forcing	June 30	68	24	29
Long Smooth Blood	July 6	73	25	26
Long Smooth Blood Red	July 6	73	26	18
New Dark Egyptian Turnip	June 26	63	31	16
Ne Plus Ultra	July 6	73	28	19
Omega	July 6	73	27	13
Perfection	July 6	73	32	15
Philadelphia Early Turnip	July 1	68	21	24
Victoria	July 6	73	20	33

Mangel Wurtzel.	Number of roots.	Av. weight in ozs.
Golden Tankard	15	64
Long Red (Bennett) *	14	117
Long Red (Howcroft)	12	142
Long Red (Thor.)	14	89
Long Yellow	18	30
Mammoth Red	17	104
Mammoth Golden	11	77
Prize Yellow Globe	12	94
Warden's Prize Orange Globe	19	70
Yellow Intermediate	10	92
Yellow Ovoid	20	82
Sugar Beet.		
Lane's Imperial	8	64
Vilmorin's Improved	11	32

*John Bennett, Seed Grower, Whatcomb, W. T.

Synonyms.

We were able to detect no difference between Crosby's Early Egyptian, Greg., '85, Dark Red Egyptian Turnip, Hen., '85, Egyptian, Howcroft, '85, and New Dark Egyptian Turnip, Thor., '85. Of the Egyptian, Greg.,'85, the roots were somewhat more flat than in the above varieties, though in other characters they appeared identical. This difference might have resulted from the use of a different standard of selection in the seed roots.

Dewing's Improved Blood Turnip, Everitt, '85, and Dewing's Extra Early Turnip, Thor., '85, were not perceptibly different, nor were the Early Bassano, Thor. 1885, and Philadelphia Early Turnip, Land. '85. The others were apparently distinct.

The Eclipse Turnip, Hend., '85, was very different in some respects from tbe same of Gregory, being much larger in size and less regular in form.

MANGEL.

The Golden Tankard, Howcroft, '85, differed very little from the Golden Tankard Beet, Land., '85, except that the roots are considerably larger.

The Long Red, Howcroft, '85, appeared the same as the Mammoth Red, Thor., 1885. The Long Red, Thor., '85, was undoubtedly the Ox Horn mangel, (*Betterave disette corne de boeuf,*) of Vil.

The Prize Yellow Globe, Sib., '85, was evidently a misnomer, and was probably the Yellow Ovoid.

CARROT.

Seeds of the following list of carrots were planted April 23 in the manner noted for the beet. The plants were thinned, when of sufficient size, to six inches apart in the rows.

Carrot.	Of edible size.	Days from planting.	Number of roots.	Av. weight in ozs.
Carentan Half Long	July 15	83	48	9
Danvers	“ 10	78	42	14
Danvers Orange Half Long	“ 13	81	38	11
Early Scarlet Horn, blunt rooted	“ 13	81	51	8
Early Scarlet Short Horn, (Fr. rouge courte hâtive)	“ 12	80	54	10
Golden Ball	“ 10	78	44	10
Half Long Pointed	“ 12	80	44	11
Half Long Scarlet Stump Rooted, (Fr. rouge demi longue obtuse)	“ 13	81	36	12
Half Long Stump Rooted	“ 11	79	34	9
James’ Intermediate	“ 15	83	33	11
Long Orange	“ 15	83	32	18
Long White	“ 12	80	33	22
Luc-New Half Long	“ 15	83	27	18
Orange Gatepost	“ 14	82	35	15

Synonyms.

The Danvers, Thor.,’ 85, was apparently the same as the Danvers Orange Half Long, Land., ’85. The Early Scarlet Horn, Blunt-Rooted, Everitt, ’85, was to all appearances the Early Scarlet Short Horn (Fr. *Rouge courte hâtive*), Vil., ’85. The Golden Ball, Everitt, ’85, was either the latter, or else the French Forcing carrot, (Fr. *Rouge très courte à chassis*, Vil.); we could not decide, as the row contained roots belonging to both these varieties.

The Orange Gatepost, Till., ’85, was probably a misnomer, as it was a pale yellow carrot.

PARSNIP.

We planted seeds from 12 differently named packages, April 23, on soil prepared as for the beet. In 1883, we stated that of the parsnips we had then grown, could all be referred to three varieties. We still find no reason for changing this opinion, though we have since tested some new names.

No difference was apparent between the Bloomsdale, Land., ’85, Large Dutch, Greg., ’85, Half Long Gurnsey (*Fr. Long de Gurnsey*), Vil., ’85, Hollow Crown, Sib., ’85, Maltese, Greg., ’85, and Sutton’s Student, Greg., ’85.

Early Round or Turnip, Greg., ’85, Short or Early Round (*Fr. rond hâtif*), Vil., ’85, and Turnip Rooted, Land., ’85, also appeared identical as did the Long, Vil., ’85, and Long White Dutch, Sib., ’85.

RADISH.

We planted seeds of the following list of radishes in the garden April 2, in rows twenty-one inches apart, and twelve feet long, one row to each name.

The attack of the radish fly was so severe as to entirely ruin the roots of many varieties, hence the date of edible size is frequently omitted.

As our first planting proved so nearly a failure, we made a second planting of the greater part of the varieties on July 20. This planting developed finely, and furnished excellent samples for description.

The data noted in the two plantings are as follows:

Radish.	First Planting.						Second Planting.	
	Of edible size	Days from planting.	First bloom.	Days from planting	First seed ripe.	Days from planting.	Of edible size.	Days from planting.
Beckert's Imp'd Chartiers	--------	----	June 22	56	Pre Sept. 15	143	Pre August 22	33
Boston Long Scarlet	--------	----	June 30	64	"	143	August 22	33
Coal Black Parisian	--------	----	July 6	72	"	143	August 24	35
Early Deep Scarlet Olive Shaped (Fr. demi long écarlate hâtif)	June 12	48	July 6	72	"	143	August 22	33
Early Long Scarlet Short top (Fr. rose hâtive)	June 16	52	July 6	72	"	143	Pre August 22	33
Early Round Dark Red	--------	----	July 6	72	"	143	August 26	37
Early Scarlet Erfurt	--------	----	July 6	72	"	143	August 22	33
Early Scarlet or Red Turnip	June 26	52	June 26	62	"	----	--------------	--------
Early Scarlet Prussian Globe	--------	----	July 6	72	Pre Sept. 15	143	--------------	--------
Early Scarlet Turnip, with white tail	June 16	52	June 30	66	"	143	--------------	--------
Early White Small Turnip (Fr. rond blanc petit hâtif	June 19	55	July 6	72	"	143	August 26	37
Early White Summer Turnip	June 12	48	June 30	64	"	143	August 22	33
Early White Summer	June 16	52	July 6	72	"	143	August 22	33
Extra Early Roman Carmine	June 15	51	July 3	69	Pre Sept. 15	143	August 22	33
French Breakfast	June 16	52	July 3	69	"	143	August 22	33
Garnet Turnip	--------	----	July 3	69	"	143	August 22	33
Giant Stuttgart Summer	June 20	50	June 26	62	"	143	August 22	33
Golden Globe (Howcroft)	June 16	52	June 26	62	"	143	--------------	--------
Golden Globe (Land)	June 19	55	June 30	66	"	143	August 26	37
Golden Summer Turnip	June 19	55	June 30	66	"	143	August 26	37
Gray Round Summer Turnip (Fr. gris d'été rond)	June 22	58	June 30	66	"	143	August 26	37
Gray Summer Turnip	June 19	55	June 30	66	"	143	August 26	37
Half Long Deep Scarlet (Thor)	June 16	52	June 30	66	"	143	August 22	33
Half Long Deep Scarlet, or Early Short Leaf, (Fr. demi long écarlate très hâtif à court feuilles.)	June 12	48	July 6	72	"	143	August 22	33
Half Long Strasburg, or White Hospital, (Fr. demi long blanc de Strasburg)	--------	----	July 8	74	"	143	August 22	33
Large White Summer, (Fr. blanc rond d'été)	June 16	52	July 6	72	Pre Sept. 15	143	August 26	37
Long Purple	June 12	48	July 6	72	"	143	August 22	33
Long Salmon	June 19	55	July 3	69	"	143	--------------	--------
Long Scarlet Short Top (Thor)	June 19	55	July 3	69	Pre Sept. 15	143	August 22	33
" " " " (Hen.)	June 12	48	June 26	62	"	143	August 22	33
Long White Naples	June 29	65	July 6	72	"	143	--------------	--------
Prussian Globe Shaped Carmine	June 19	55	June 29	65	"	143	August 22	33
Purple Turnip	June 19	55	June 29	65	"	143	--------------	--------
Rat-tail, or Japan	--------	----	July 3	72	"	143	--------------	--------
Scarlet Olive Shaped, (Fr. demi long rose)	June 16	52	July 3	72	Pre Sept. 15	143	August 22	33
White Giant Stuttgart, (Fr. Blanc Géant de Stuttgart)	--------	----	June 28	64	"	143	August 24	35
White Lady Finger	June 18	54	July 3	72	"	143	August 22	33
White Strasburg Summer, (Thor.)	June 16	52	July 3	72	"	143	August 22	33
White Strasburg Summer, (Vil.)	June 16	52	July 3	72	"	143	August 22	33
White Tipped Scarlet Turnip	June 16	52	July 6	75	"	143	August 25	36
White Turnip, (Fr. Rond blanc.)	June 22	58	July 6	75	"	143	August 22	33

Radish.	First Planting.						Second Planting.	
	Of edible size.	Days from planting.	First bloom.	Days from planting.	First seed ripe.	Days from planting.	Of edible size.	Days from planting.
Wood's Early Frame (Hen.)	June 17	53	July 3.	69	Pre Sept. 15	143.	August 26	37
“ “ “ (Howcroft.)	June 12	48	July 3.	69	“	143.	August 26	37
“ “ “ (Thor.)	June 19	55	July 3.	69	“	143.	August 22	33
Yellow Summer Turnip	June 16	52	July 3.	69	“	143.	August 26	37
Yellow Summer	--------	----	July 6.	72	“	143.	August 22	33
Winter Radish.								
Black Spanish, long			June 26	62	Pre Sept. 15	143.		
Black Spanish, round			July 6.	72	“	143.		
California Large White			--------	----	“	143.		
Long Gray White			July 6.	72	“	143.		
Scarlet Chinese			June 30	66	Pre Sept. 15	143.		
White Spanish			June 30	66	“	133.		

Synonyms.

The plants bearing the following names seemed identical:

Early Scarlet Erfurt, Land., '85, and Extra Early Roman Carmine, Thor., '85.

Giant Stuttgart Summer, Thor.,'85, and White Giant Stuttgart, (*Fr. blanc géant de stuttgart*), Vil., '85.

Gray Summer Turnip, (Thor., '85), and Gray Round Summer Turnip (*Fr. gris d'été rond*), Vil., '85.

White Strasburg Summer, Thor. '85, and White Strasburg (*Fr. demi-long blanc de Strasbourg*), Vil., '85.

The plants bearing the other names appeared distinct.

TURNIP AND RUTA-BAGA.

Seeds of the list of turnips given below were planted July 16, and of the Ruta-bagas June 1, one row of each twelve feet long, the rows three and a half feet apart. The turnips were thinned when of sufficient size to four inches, and the ruta-bagas to ten inches apart in the row. The number and average weight of the roots, which were harvested November 10, were as follows:

Turnip.	Number of roots.	Av. weight in ozs.
Green Barrel	31	11
Green Globe	18	23
Green Top Yellow Aberdeen	19	8
Improved Purple Top Mammoth	7	31
Long White Strap Leaf	19	15
Long White Tankard	18	12
Montmagny Yellow Purple Top Flat	26	8
Pomeranian White Globe	16	10
Purple Top Yellow Aberdeen	6	11
Purple Top White Globe	7	9
Robson's Golden Ball	4	17
White Strap Leaf	22	16
Yellow Malta	2	14

Ruta-Baga.	Number of roots.	Av. weight in ozs.
Curly Top	4	40
Laing's	14	14
Laing's Strap Leaf	18	46
Sutton's Champion	12	39
Westbury Purple Top	13	34

Synonyms.

The Improved Purple Top Mammoth, Ferry, '85, and the Purple Top White Globe, Howcroft, '85, appeared identical.

The Laing's Strap-Leaf ruta-baga, Howcroft, '85, was evidently a misnomer, as the plants were not "strap-leaved."

Sample packets of four varieties of turnip were sent to us for trial from the Department of Agriculture, and were tested for purity. The names were Purple Top Strap Leaf, White Flat Dutch, White Norfolk and Yellow Aberdeen.

The "White Flat Dutch," proved to be the same as the Early White Flat Dutch Strap-Leaved, Fer., '83. The "Yellow Aberdeen" was the purple topped variety of this name, but many of the roots of this and of the White Norfolk were off type; no more so, however, than have been roots of many other samples tested.

ONION.

Seeds of the following list were planted in the garden April 23, in rows twenty-one inches apart, on soil prepared as noted for the beet. The plants were thinned when sufficiently large to one inch apart. The different rows were marked "ripe" when the tops had all, or nearly all fallen down.

In order to make the comparison of the average weights of the bulbs more accurate, and at the same time to avoid the use of decimals, we compute the weight in ounces for one hundred average bulbs, instead of a single root as in the case of the beet and carrot.

Onions.	Date when ripe.	Days from planting	Number of Scallions.	Number of Bulbs.	Weight calculated ⅌ 100 bulbs
					ozs.
Bedfordshire Champion	Oct. 3	163	9	20	338
Bloomsdale Extra Early Red	Aug. 18	117	0	41	
Dark Red August (Fr. rouge vif d'aout)	Sept. 5	135	0	21	361
Early Red Flat (Thor.)	Aug. 20	119	0	69	216
Early Red Flat (Vil.)	"	119	0	94	195
Early Pearl	Sept. 1	131	5	55	365
Early White Round	Aug. 18	117	0	53	75
Extra Early Bloomsdale, red	Aug. 22	121	0	68	127

Onions.	Date when ripe.	Days from planting.	Number of Scallions.	Number of Bulbs.	Weight calculated ⅌100 bulbs
Extra Early Flat Red	Aug. 22	121	0	54	
Fejina	July 30	97	0	31	68
Flat Maderia	Sept. 23	153	1	30	466
Giant Red Italian Tripoli	Sept. 27	157	0	41	483
Giant Rocca (Hen.)	Sept. 1	131	2	38	463
Giant Rocca (Thor)	"	131	0	47	608
Giant White Garganus	Aug. 22	121	0	49	308
Giant White Italian Tripoli	"	121	0	29	160
Globe Maderia	Oct. 3	163	7	15	890
Golden, (Fr. jaune.)	Sept. 15	145	2	41	284
Golden Queen	Oct. 3	163	4	35	351
Improved Hard Russian	"	163	0	60	413
Large Red	Sept. 5	135	2	58	414
Large Red Globe	Sept. 15	145	3	50	542
Large Red Globe Southport (Hen.)	Sept. 5	135	3	58	457
Large Red Globe Southport (Thor.)	Sept. 4	136	1	45	455
Large Red Wethersfield	Sept. 4	136	1	59	408
Mammoth Silver	Sept. 15	145	0	12	
Mammoth Silver King	Aug. 22	121	0	52	327
Nasbey's Mammoth	Sept. 20	150	6	35	450
Neapolitan Marzagole	Aug. 22	121	0	47	180
New Queen (Greg.)	Aug. 1	100	0	51	65
New Queen (Sib.)	July 30	97	0	14	
Pale Red Bermuda	Sept. 3	133	0	59	445
Pyramid, or Vesuvius	Sept. 25	155	11	22	419
Queen	Aug. 10	109	0	32	50
Southport White Globe	Oct. 3	163	3	14	625
Southport Yellow Globe	Sept. 28	158	2	22	605
White Globe (Thor.)	Oct. 1	161	0	8	637
White Globe (Fr. blanc Globe), (Vil.)	Sept. 15	145	0	73	416
White Portugal, (Thor.)	"	145	1	49	407
White Portugal, or Silver Skinned (Hen)	"	145	1	38	455
Yellow Danvers	Sept. 5	135	0	5	540
Yellow Dutch, or Strasburg	Sept. 29	159	1	9	716
Yellow Globe	"	159	1	35	571
Yellow Globe Danvers (Hen.)	Sept. 15	145	1	21	712
Yellow Globe Danvers (Thor.)	Sept. 30	160	0	18	673
Yellow Russian (Fr. jaune de Russiee).	Sept. 15	145	8	39	307
Yellow Hard Russian Imp'd (Fr. jaune dur de Russiee	Sept. 18	148	9	106	162
Yellow Straw Colored (Fr. jaune paille des Vertus)	Oct. 3	163	7	29	443
Yellow Villefranche (Fr. jaune de Villefranche	Sept. 5	135	2	75	257

Synonyms.

We have not as yet (Nov., 1885) found the time to make the careful study of the bulbs of the different names, to warrant us in saying with any degree of confidence which ones, if any, are synonyms. We must, therefore, postpone our testimony in this case until our next report.

Tests with Large and Small Onion Seed.

Onion seeds vary considerably in size, even when gathered from the same plant. In order to discover whether the individual bulb is influenced by the size of the seed that produces it, we sifted the seed of nine packages, and planted the large and small seed in different rows. The results appear in the following table.

	Large Seed.					Small Seed.				
	Date when ripe.	Days from planting.	Number of Scallions.	Number of Bulbs	Av. weight of bulbs per hundred	Date when ripe	Days from planting.	Number of Scallions	Number of Bulbs	Av. weight of bulbs per hundred
					ozs.					ozs.
Bedfordshire Champion	Oct. 3	163	9	20	400	Oct. 3	163	6	35	303
Bloomsdale Extra Early Red	Aug. 20	119	0	56	......	Aug, 18	117	0	27	......
Early Red Flat (Thor.)	"	119	0	69	217	Aug. 20	119	0	69	214
Early Red Flat (Vil.)	"	119	0	98	195	"	119	0	89	194
Early White Round	Aug. 18	117	0	62	119	Aug. 18	117	0	45	153
Extra Early Bloomsdale Red	Aug. 22	121	0	70	183	Aug. 22	121	0	67	69
Giant Rocca	Sept. 1	131	1	48	531	Sept. 1	131	0	47	671
Giant White Garganus	Aug. 22	121	0	48	302	Aug. 22	121	0	50	310
White Globe	Sept. 15	145	0	66	452	Sept. 15	145	0	81	400
Average		128		60	300		128		57	289

It appears that the very slight difference is in favor of the large seed. The bulbs of Extra Early Bloomsdale Red from the large seed weighed more than double those from the small seed, a difference which is much more marked than in the other varieties. Had this variety not been planted, the difference would have been in favor of the small seed. We cannot, therefore, consider the question settled from this experiment.

Compact vs. Loose Soil for Onions.

In 1883 our experiments indicated that a compact soil, with a mellow surface may be favorable to yield in the onion. In 1884, a similar experiment, on a larger scale, though the crop was nearly a failure, gave some evidence in the opposite direction.

We repeated the experiment the past season, and the result judged from appearances was decidedly in favor of the loose soil. Through the blunder of an assistant, the crop was not weighed. The difference, however, was so decided as to cause remarks and questions from many visitors to our garden.

MELON.

We made two plantings of the melon. The first May 19, on inverted sods in the cold frame, and the second May 26, in the open ground.

The latter planting was made in drills prepared by digging trenches a foot wide, eight inches deep, and twelve feet long, placing in the bottom of each a layer of well rotted manure three inches deep, covering this with the soil thrown out. Thus a slight ridge of mellow earth was formed, on which the seeds were planted about 2 inches apart. The drills were 7 feet apart.

On June 22, plants were taken from the cold frame and set out in these drills wherever vacancies appeared more than a foot in length, and later the surviving plants were thinned to at least a foot apart in the drills.

The following data were noted:

Musk Melon.	First bloom.	First fruit ripe.
Acme Citron	July 9	Sept. 14
Allen's Superb	" 13	" 18
Arlington Green Fleshed	" 9	" 17
Bay View (Hen.)	" 10	" 14
Bay View (Sib.)	" 9	" 24
California Nectar (Hen.)	" 10	" 19
California Nectar (Sib.)	" 8	" 21
California Yellow Fleshed Citron	" 16	" 20
Casaba	" 9	" 19
Cavaillon Red Fleshed, (Fr. de Cavaillon à chair rouge)	" 20	Oct. 9
Colorado, or Banana	" 13	Sept. 17
Early Nutmeg	" 10	" 21
Early White Japan	" 9	" 19
Fine Valparaiso	" 10	" 29
Golden Netted Gem	" 10	" 14
Green Citron (Greg.)	" 14	" 21
Green Citron (Hen.)	" 10	" 14
Green Montreal	" 10	" 19
Grower's Pride	" 9	" 4
Hackensack	" 13	" 19
Hardy Ridge	" 11	-------
Improved Christiana	" 13	Sept, 30
Improved Green Nutmeg	" 9	" 19
Japan Coral Fleshed	" 10	" 21
Jenny Lind Citron	" 9	" 14
Large Yellow Cantaloupe	" 9	" 14
Long Persian	" 13	Oct. 1
Miller's Cream Nutmeg	" 9	Sept. 27
Montreal Market	" 9	Prior Sept. 18
Netted Gem	" 9	" 17
Netted Nutmeg	" 9	" 19
New Golden Perfection	" 15	-------
New Surprise	" 9	Sept. 18
Oblong Netted (Fr. maraîcher de Saint Laud)	" 9	" 27
Odessa	" 23	" 18
O. K. Netted Gem	" 9	" 17
Passy Cantaloupe (Fr. cantaloup de Passy)	" 10	" 25
Pine Apple	" 16	" 27
Prolific Nutmeg	" 9	" 15
Shaw's Golden Superb	" 13	" 27
Sills' Hybrid (Greg.)	" 13	-------
Sills' Hybrid, (Thor.)	" 13	-------
Skillman's Fine Netted	" 13	Sept. 29
Skillman's Netted	" 13	" 19
Surprise	" 9	" 14
Sutton's Green Citron	" 10	" 19
Watermelon.		
African	July 28	Sept 27
Dark Icing, or Ice Rind	" 20	" 24
Early Mountain Sprout	" 15	" 6
Goodwin's Imperial	" 22	" 25
Ice Cream	" 23	" 19
Landreth's Boss	" 22	" 19
Landreth's Long Light Rind	" 25	" 27

It appears that all of the varieties except three, viz: the Hardy Ridge, New Golden Perfection and Sill's Hybrid, are marked as having ripened at least one fruit. The Grower's Pride was earliest, maturing its first fruit September 4th.

About August 27 we were visited with a cold period, and for three successive days a chilly north wind blew. Although the mercury did not descend below forty-five degrees, the melon vines seemed to be affected as if injured by a slight frost. The shriveling of the leaves increased until towards the middle of September, when the plants appeared to have died. The fruits on the greater part of the plantings, therefore, did not ripen naturally, and hence we were able to make no notes as to the comparative quality of the different kinds, nor but few descriptive notes.

The Netted Gem, Hen., '85, Golden Netted Gem, Thor., '85, and O. K. Netted Gem, Everitt, '85, appeared identical.

Of the watermelons we planted but few varieties, as our past experience with this fruit has proved very discouraging. With the exception of the Early Mountain Sprout, which ripened rather early in September, the varieties noted in the table ripened in the same manner as those of the muskmelon,—through the dying of the foliage.

CUCUMBER.

The varieties of cucumber were planted in precisely the same manner as those of the melon, with the exception that the seeds of the first planting were planted in the cold frame May 20, instead of May 19th.

We noted the following data:

Cucumber.	First bloom.	Of pickle size.	First fruit ripe.
Carter's Best of All	July 15	July 28	Aug. 19
Early White Japan	“ 10	Aug. 1	Aug. 25
Green Prolific Pickling	“ 9	July 28	Aug. 25
Jersey Pickle	“ 20	Aug. 4	Sept. 15
Landreth's First	“ 9	July 30	Sept. 1
Large White Bonneuil	“ 13	Aug. 1	Aug. 31
O K. Perfect Pickling	“ 13	“	Sept. 25
Peerless White Spine	“ 10	“	Oct. 7
Short Prolific Pickle	“ 13	July 30	Aug. 22
Turkey Long Green	“ 10	Aug. 1	Aug. 26
Very Long Green China, (Fr. vert trés long de Chine)	“ 9	July 27	Aug. 26
White German	“ 10	Aug. 1	Sept. 2
White Japan (Greg.)	“ 10	July 30	Aug. 27
White Japan (Till.)	“ 10	July 27	Aug. 27

The varieties were noted "of pickle size" when the first fruits were of the size of the little finger. It appears that the Very Long Green China (*Fr. vert très long de Chine*), Vil., 85, attained this size earliest, though there was practically little difference in the different plantings. The plants of the Jersey Pickle, Land., '85, did not prosper, which may account for the lateness of this variety.

Synonyms.

The Landreth's First, Land., '85, appeared the same as the Turkey Long Green of same source.

The O. K. Perfect Pickling, Everitt, '85, was not distinguishable from the Peerless White Spine, Greg., '85.

The White Japan, Greg., '85, also Till., '85, was the same as the Early White Japan, Thor., '85.

Experiment in pinching the terminal shoots.

We repeated with the cucumber the experiment tried in 1884 with the melon; that of pinching off the ends of the runners when they had attained the length of two to three feet. The experiment was made on two rows of the White Spine variety each containing 52 plants. The pinching was commenced July 22, and the vines were passed over at frequent intervals, and all shoots or branches pinched back as they attained the length noted, until growth ceased. The cucumbers were gathered as fast as they became of pickle size, the first picking being made July 29, and the last Oct. 4; and the yield of each day was counted and weighed. We give the results in the following table, in which the yield for each week is given separately.

	Pinched Row.			Unpinched Row.		
	Number.	Weight.		Number.	Weight.	
July 29 to Aug. 4 incl......	429	7 lbs.	$2\frac{5}{16}$ oz.	272	4 lbs.	$8\frac{5}{8}$ oz.
Aug. 5 “ “ 11 “	244	4 “	1 “	196	3 “	$4\frac{3}{16}$ “
“ 12 “ “ 18 “	265	5 “	$3\frac{3}{16}$ “	308	5 “	$9\frac{1}{8}$ “
“ 19 “ “ 25 “	485	6 “	$15\frac{3}{8}$ “	371	6 “	$5\frac{3}{16}$ “
“ 26 “ Sept. 1 “	256	2 “	$14\frac{1}{16}$ “	192	3 “	$0\frac{3}{16}$ “
Sept. 2 “ “ 8 “	138	2 “	$8\frac{5}{16}$ “	168	3 “	$9\frac{3}{4}$ “
“ 9 “ “ 15 “	153	2 “	$11\frac{11}{16}$ “	177	3 “	$11\frac{15}{16}$ “
“ 16 “ “ 22 “	68	2 “	$2\frac{1}{8}$ “	62	1 “	$7\frac{15}{16}$ “
“ 23 “ “ 29 “	20	0 “	$6\frac{7}{8}$ “	58	1 “	$12\frac{7}{16}$ “
“ 30 “ Oct. 4 “	57	1 “	$15\frac{7}{16}$ “	97	3 “	$9\frac{3}{4}$ “
Total	2115	36	$0\frac{3}{8}$	1901	36	$15\frac{1}{8}$

It appears from the table that during the first two weeks after the plants commenced bearing, the pinched vines gave the larger yield. Later however, the unpinched ones gave the larger yield. The totals show that there was no marked difference in the product of the two rows, the pinched one exceeding slightly in the number of pickles, and the unpinched one in weight. We could hardly expect that two rows similarly treated would give more nearly equal results, and hence we infer that in this experiment the pinching was not followed by any marked increase in yield.

SQUASH.

Seeds of the following list of squashes were planted in the garden May 27, in drills prepared as for the melon, twelve feet long, and seven feet apart, one drill to each name. The seeds were placed about two inches apart, and the plants thinned as they commenced running, to one foot apart. Circumstances proved very favorable to the growth of the vines, and long before the growing season had passed, the ground was densely covered with foliage, making it difficult to trace the rows.

In the table we have noted the date at which the different rows formed the first fruit four inches in diameter, calling this stage at edible size. The distinction when applied to both summer and winter squashes, becomes arbitrary, but no more accurate method of measuring the comparative development of the different varieties has appeared to us.

Squash.	First bloom	Days from planting.	Of edible size.	Days from planting.
Boston Marrow	July 20	154	Aug. 3	168
Brazilian Sugar, (Fr. Sucriere du Brésil)	" 20	154		
Canada Crookneck	" 27	161	Aug. 5	170
Cocoanut	" 20	154	" 5	170
Geneva Bush, (Fr. Courgeron de Genève)	" 13	147	" 4	169
Green Striped Bergen	" 15	149	" 3	168
Green Striped Bush	" 15	149	" 4	169
Hubbard	" 20	154		
Landreth's White Turban	" 27	161	Aug. 8	173
Little Cocoanut	" 20	154	" 6	171
Long Green Crookneck	" 20	154	" 8	173
Low's Premium Hybrid	" 23	157		
Mammoth Chili	" 22	156		
Marblehead	" 22	156		
New Marblehead	" 22	156		
New Olive	" 23	157		
Patagonian, (Fr. des Patagons)	" 20	154	Aug. 6	171
Striped Custard Marrow, (Fr. Patisson panaché)	" 20	154	" 8	173
Turban	" 30	164		
Vegetable Marrow, (Fr. à la moelle)	" 15	149	Aug. 3	168
White Warted Flat Custard Marrow, (Fr. blanc plat galeux)	" 15	149	" 4	169
Yellow Elector's Cap, (Fr. Patissons jaune	" 17	151	" 3	168

Synonyms.

The Yellow Elector's Cap. (*Fr. Patisson jaune,*) Vil., '85 was the same as the Early Yellow Bush Scallop. Sib., '83.

The Marblehead, Hen., '85 and the New Marblehead, Thor. '85 were the same, and the New Olive, Thor., '85 was the same as the Olive, Vil., '84 grown last year.

The Geneva Bush squash (*Fr. Courgeron de Genève*), Vil., '85 was a very thin fleshed variety that appeared to have little value in our climate.

CABBAGE.

Seeds of the following list of cabbages were planted in boxes in the greenhouse Mar. 30. As the plants became sufficiently large, sixteen of each, with a few exceptions, were transplanted to the garden, in rows three and a half feet apart, and eighteen inches apart in the row. The transplanting commenced with the earlier varieties Apr. 27, and ended May 18.

The soil was prepared as described for the beet, and was kept free from weeds, and well cultivated during the season.

The damage from the cabbage fly was quite serious, which necessitated resetting the plants several times.

On June 22 and 26 the remaining plants of the different varieties were set out in the same manner as those set earlier but on rather less fertile soil. These constitute the "late planting" in the table. The data noted are as follows:

Cabbage.	Early Planting.						Late Planting.					
	First head formed.	Days from planting.	No. of plants survived	No. of heads formed.	Av. diam. of heads,—in.	Av. wt. heads —ounces.	First head formed	Days from planting.	No. of plants survived.	No. of heads formed.	Av. diam. of heads,—in.	Av. wt. heads —ounces.
Bacalan Late, (Fr. Bacalan gros)	Aug. 10	131	12	12	5½	45	Sept. 15	167	4	4	5	92
Bloomsdale Brunswick	" 12	133	29	22	9	100	Oct. 7	189	9	7	7	64
Bloomsdale Bullock-Heart	" 10	131	21	21	8	93	Sept. 27	179	6	6	8	77
Brunswick Short Stem, (Fr. de Brunswick à pied court)	" 12	133	15	5	9½	99	" 30	182	6	4	9	82
Cannon Ball	" 10	131	10	10	6	45	" 19	171	4	3	6	58
Danish Drumhead	" 4	125	15	12	8	72	" 30	182	4	3	7½	65
Dark Red Drumhead, (Fr. rouge gros)	" 4	125	13	13	6½	69	Nov. 10	223	10	8	6	40
Dark Red Pointed Headed, (Fr. rouge conique)	July 20	112	12	12	5½	51						
Dax, (Fr. de Dax)	Nov. 10	225	12	8	9½	98	Oct. 17	198	6	2	9	103
Earliest Blood Red Erfurt	July 25	117	14	14	4½	24						
Earliest White Erfurt	Aug. 6	127	14	14	5½	42	Sept. 6	158	22	22	5½	38
Early Bacalan, (Fr. Bacalan hâtif)	" 6	127	12	12	6½	53	Sept. 10	162	8	7	7	72
Early Bleichfeld	" 4	125	15	11	7	52						
Early Cone	" 6	128	21	21	6	37	Sept. 21	174	7	7	7	64
Early Dark Red Dutch, (Fr. rouge petit)	" 28	149	10	10	7	68	" 15	167	10	7	4½	33
Early Dark Red Erfurt (Greg)	" 3	125	15	15	5½	35	" 15	168	3	3	5½	41
Early Dark Red Erfurt (Vil.) (Fr. rouge foncé hâtif d' Erfurt)	July 20	110	11	11	4½	27	" 10	162	11	11	4½	26
Early Deep Head	Aug. 25	147	15	9	9½	102	" 15	168	6	5	11½	161
Early Dutch Drumhead, (Fr. de Hollande pied court)	Aug. 25	123	15	11	7	56	" 15	168	7	7	6½	49
Early Jersey Wakefield	" 12	134	10	10	6½	44						
*Early Ox-Heart (Vil.) (Fr. coeur de boeuf petit)	" 10	122	14	14	6½	33	" 12	155	11	11	5½	35
Early Ox-Heart (Greg.)	" 10	132	15	15	7	64						
Early Paris	" 10	132	10	10	7½	44						
Early Paris Market, (Fr. coeur de boeuf moyen de la halle)	" 4	125	15	15	6½	41	Oct. 17	199	6	6	7½	84
Early Winnigstadt	" 3	125	21	21	6	53						
Early York (Greg.)	" 12	134	19	19	6	53						
Early York (Vil.) (Fr. d'York petit hâtif)	" 6	127	12	12	6	61						
Enfield Market	" 14	136	19	18	6	51	Oct. 17	200	4	4	5½	40
Fottler's Improved Early Brunswick	" 6	128	20	20	10	145						
Fuuel, (Fr. de Fuuel)	" 12	133	13	3	8½	78						
Garfield Pickling	" 12	132	13	11	5½	48	Oct. 17	200	9	8	5	31
Green Glazed	Nov. 10	224	7	1	5½	32						
Habas, (Fr. de Habas)	" 10	223	14	3	8½	71						
Henderson's Early Summer (Greg.)	Aug. 4	125	10	10	8	64	Sept. 15	167	7	5	5½	64
Henderson's Early Summer, (Hen.)							Oct, 17	157	5	5	8½	89
Landreth's Earliest	July 13	103	10	10	5½	33						
Landreth's Large York	Aug. 4	125	13	13	6½	47						
Large Late Flat Brunswick, (Fr. de Brunswick ordinaire)	" 1	122	13	12	7½	61	Oct. 17	199	10	9	7½	62
Large Ox-Heart (Vil.) (Fr. coeur de boeuf gros)	" 4	125	11	11	7	48						
Large Ox-Heart, (Greg.)	July 27	117	15	14	7	49						
Large York, (Greg.)	Aug. 4	125	21	21	6	53						
Large York (Vil.), (Fr. d'York gros)	" 6	127	12	12	6	61						
Late Flat Dutch (Vil.), (Fr. de Hollande tardif)	" 10	132	11	11	7	48	Sept. 15	168	5	5	10	140
†Late Flat Dutch (Till.)							Oct. 17	157	7	7	8½	93
Lingreville (Fr. de Lingreville	" 12	133	15	13	7	53	Sept. 10	163	9	7	6	50
Little Pixie	" 5	126	14	14	8½	99	" 21	173	6	6	7½	64
Low's Early Peerless	" 6	127	10	10	8	71	" 21	173	2	2	7½	90

* Planted April 10. † Seeds planted May 13; plants transplanted with the others.

Cabbage—Continued.	Early Planting.						Late Planting.					
	First head formed.	Days from planting.	No. of plants survived	No. of heads formed.	Av. diam. of heads,—in.	Av. wt. heads ounces.	First head formed.	Days from planting.	No. of plants survived	No. of heads formed.	Av. diam. of heads,—in.	Av. wt. heads —ounces.
Marbled Burgundy, (Fr. marbré de Bourgogne)	Aug. 10	131	14	13	5½	38	Oct. 17	199	10	10	5½	44
Marblehead Dutch	“ 20	141	13	12	9	103	“ 17	199	11	5	7	64
Marblehead Mammoth	“ 12	133	21	16	10	143						
Newark Early Flat Dutch	July 20	110	23	23	8	63	Sept. 22	174	6	5	8½	100
Nonpareil Early	“ 28	118	15	14	6	45						
Original Fottlers	“ 25	115	24	23	7½	57						
Padilla Purple Pickling	Aug. 6	127	14	14	5½	43						
*Pomeranian, (Fr. conique de Poméranie)	“ 6	118	13	13	6½	69	Sept. 12	155	9	9	6½	64
Premium Flat Dutch	“ 12	133	29	26	9½	135						
Quintal Drumhead, (Fr. quintal)	Sept. 15	167	11	11	9½	92	Oct. 17	199	10	8	8½	73
Red Drumhead	Aug, 8	129	13	13	6	58						
Red Dutch	“ 8	129	10	10	6½	57	Oct. 17	199	16	15	5½	37
Saint Dennis Drumhead, (Fr. de Saint Denis)	“ 22	143	12	12	8½	103						
Saint John's Day Early, (Fr. Joanet hâtif	July 28	118	11	11	6½	43						
Saint John's Day Late, (Fr. Joanet gros)	“ 28	118	12	12	7	50						
Schweinfurt, (Fr. de Schweinfurt)	Aug. 15	136	7	5	10	116						
Schweinfurt Quintal)	“ 4	125	9	9	11½	118						
Stone Mason	“ 28	149	11	10	11	154						
Sugar Loaf (Greg.)	“ 12	133	22	22	5½	41						
Sugar Loaf (Vil.), (Fr. pain de sucre)	“ 10	131	12	11	6	48						
Sure Head	“ 20	141	12	10	9	107						
The Warren	“ 12	133	12	11	8½	88						
Tourleville (Greg.)	“ 28	149	21	14	7½	73						
Tourleville (Vil.), (Fr. de Tourleville)	“ 6	127	13	12	7	59	Sept. 30	182	11	6	7	79
Vaugirard, (Fr. de Vaugirard)	“ 12	133	14	13	7½	63						
Very Early Etampes	“ 3	124	20	20	5½	52	Sept. 27	189	11	10	6½	45
Vilmorin's Early Flat Dutch	“ 12	133	6	6	8½	94						
Wheeler's Cocoanut	“ 10	131	26	25	6½	53						
Wheeler's Imperial	“ 10	131	11	11	5	31	Sept. 15	167	9	8	6	50
Winnigstadt, (Fr. pointu de Winnigstadt)	July 30	120	14	14	5½	46						

Cabbage Savoy.	Early Planting.						Late Planting.					
	First head formed.	Days from planting.	No. of plants survived.	No. of heads formed.	Av. diam. of heads,—in.	Av. wt. of heads,—ozs.	First head formed	Days from planting.	Number of plants	No. of heads formed	Av. diam. of heads,—in.	Av. wt. of heads,—ozs.
Dwarf Early, (Fr. court hâtif)	Sept. 15	169	14	13	8	66						
Drumhead	Aug. 25	148	18	18	7½	56						
Early Ulm	“ 12	135	17	14	7	77	Sept. 27	181	9	9	5	29
Golden, (Fr. doré)	Oct. 19	203	14	8	5½	45	Nov. 10	225	6	5	6	57
Green Globe, (Fr. ordinaire)	Sept. 15	169	14	6	6	40	Nov. 10	225	10	6	5½	32
Improved American	Aug. 12	135	20	18	7½	71						
Large Late Winter Drumhead (Fr. de Pontoise	Sept. 12	166	23	11	6½	47						
Large Vertus, (Fr. gros de Vertus)	Aug. 25	148	14	14	7	91						
Long Headed, (Fr. à tête longue	Oct. 9	193	15	2	5½	50	Nov. 10	225	9	6	6	38
Norwegian, (Fr. de Norvége)	Sept. 12	166	17	12	7½	64						
Small Early Ulm, (Fr. petit hâtif d'Ulm)	Aug. 4	127	14	8	4½	27						
Tom Thumb	“ 12	135	15	9	6	46	Nov. 10	225	21	12	6½	53
Tours, (Fr. pancalier de Touraine)	Sept. 15	169	25	15	5½	31	“	225	9	8	7½	50
Very Curled Limay, (Fr. très frisé de Limay)	--------	----	26	0	----	----	--------	----	11	0	----	----
Very Early Paris, (Vil.) (Fr. très hâtif de Paris	July 2	94	30	30	5	25	Sept. 10	164	31	28	5	32
Very Early Paris (Greg.)	“ 13	105	28	27	5½	27						
Victoria	Sept. 15	169	24	16	6½	50	Nov. 10	225	10	1	8	66

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* Planted April 10.

It appears that the earliest variety was the Very Early Paris Savoy, Greg., '85 which formed a head of edible size in ninety-four days from planting. The earliest smooth leaved variety, red cabbages excepted, was the Landreth's Earliest, Land., '85, which formed its first head in 103 days from planting.

The largest and heaviest heads were from the Stone Mason, Greg., '85, which produced from eleven plants, ten heads averaging eleven inches in diameter, and 154 ounces in weight.

Fottler's Improved Early Brunswick, Greg., '85 from twenty plants formed twenty heads averaging ten inches in diameter, and 145 ounces in weight. It appears also that the Premium Flat Dutch, Greg., '85, Schweinfurt Quintal, Greg., '85, Schweinfurt, Vil., '85, Sure Head, Everitt '85, Saint Dennis Drumhead, Vil., '85, and Marblehead Dutch, Greg., '85 did very well. The Marblehead Mammoth, Greg., '85 produced some very superior heads, though several plants formed no heads.

The Little Pixie, Greg., '85, was evidently wrongly named, as was a packet of Henderson's Early Summer, Land., '85, one of Green Glazed (*Fr. vert glace d'Amerique*), Vil., '85, and one of Early Wyman, Greg., '85. The last three are not included in the table. The plants of Bloomsdale Bullock Heart, Land., '85 were extremely variable, but a single plant being of the Oxheart shape.

Several differently named cabbages bore a very close resemblance to each other. We hesitate to declare such as synonyms however, until a further acquaintance with the varieties. We note those which bore the closest resemblance.

Early Dutch Drumhead, Vil., '85, Newark Early Flat Dutch, Greg., '85, and Original Fottler's, Greg., '85.

Premium Flat Dutch, Greg., '85 and Sure Head, Everitt, '85.

Landreth's Large York, Land., '85 and Large York, Vil., '85.

In several other cases the heads of two differently named cabbages were exactly similar in form and color, but differed considerably in size, or in the proportion of plants that formed heads. The Early Deep Head; and Late Flat Dutch are examples of this kind. It is a question whether, in such cases, the differences may not be more due to the selection of seed plants, than to variety characters.

Large vs. small cabbage seed.

As in the onion, the seeds of cabbage vary considerably in size. As an experiment, we sifted the seeds of eleven packets of Savoy and twenty-one of cabbags, and planted the large and small seed separately. The results were as follows:

Cabbage.	Large Seed.						Small Seed.					
	First head formed.	Days from planting.	Number of plants.	Number of heads	Av. diameter in inches	Av. weight in ounces.	First head formed.	Days from planting.	Number of plants	Number of heads	Av. diameter in inches	Av. weight in ounces.
Bloomsdale Brunswick	Aug. 10	131	13	11	9½	106	Aug. 12	133	16	11	9	94
Bloomsdale Bullock's Heart	" 10	131	10	10	8	90	" 10	131	11	11	8½	96
Early Cone	" 6	128	13	13	6	39	" 10	132	8	8	6	36
Early Deep Head	" 25	147	15	9	9½	112	" 25	147	9	9	9½	92
Early Ox Heart	" 10	132	11	11	7½	76	Sept. 15	168	4	4	7	52
Early Winnigstadt	" 3	125	12	12	6	46	Aug. 4	126	9	9	6	60
Early York	" 12	134	10	10	6	56	" 3	125	9	9	6	51
Enfield Market	" 17	139	11	10	6½	57	" 14	136	8	8	6	45
Fottler's Improved Early Brunswick	" 6	128	9	9	11	169	" 12	134	11	11	9	121
Large Ox Heart	" 12	133	12	12	7½	54	July 27	117	15	14	6	44
Large York	" 4	125	12	12	5	35	Aug. 4	125	9	9	7	72
Marblehead Mammoth	Sept. 15	167	12	7	9½	161	" 12	133	9	9	10½	126
Newark Early Flat Dutch	July 20	110	11	11	8	59	" 10	131	12	12	8	67
Nonpareil Early	Aug. 4	125	6	6	6½	48	July 28	118	9	8	5½	42
Original Fottlers	July 25	115	13	12	7½	52	Aug. 4	125	11	11	8	63
Premium Flat Dutch	Aug. 12	133	15	13	10½	137	" 12	133	14	13	6	133
Sugar Loaf	" 12	133	11	11	5½	36	" 12	133	11	11	9	46
Tourleville	" 28	149	10	6	7½	75	" 28	149	11	8	7½	72
Very Early Etampes	" 5	126	11	11	5½	63	" 4	125	9	9	5½	41
Vilmorin's Early Flat Dutch	Sept. 15	167	1	1	9½	126	" 12	133	5	5	7½	63
Wheeler's Cocoanut	Aug. 10	131	14	14	6½	51	" 12	133	12	11	6½	55
Average		134			8	81½		133			7⅓	70

Cabbage—Savoy.												
Dwarf Early, (Fr. court hâtif)	Sept. 15	169	8	7	8	68			6	6	8	65
Drumhead	Aug. 5	128	13	13	8	85	Aug. 24	147	5	5	7	31
Early Ulm	" 12	135	11	8	6	37	" 25	148	6	6	8½	125
Improved American	Sept. 15	169	7	7	7½	72	" 12	135	13	11	7½	70
Large Late Winter Drumhead (Fr. de Pontoise)	" 15	169	9	2	4½	18	Sept. 12	166	14	9	7	64
Long Headed, (Fr. à tête longue)	Oct. 9	193	15	2	5½	50	Oct. 9	193	6	4	½	54
Norwegian, (Fr. de Norvége)	Sept. 12	166	7	7	8	64	" 3	187	10	5		64
Tours, (Fr. Pancalier de Touraine)	Sept. 15	169	12	10	5½	31	Sept. 15	169	13	5	5½	32
Very Early Paris (Vil.) (Fr. trés hâtif de Paris)	Aug. 4	127	15	15	5	21	July 2	94	15	15	5	28
Very Early Paris (Greg.)	July 13	105	14	14	5½	24	" 31	123	14	13	5½	29
Victoria	Sept. 15	169	12	9	6½	49			12	9	6½	51
Average		154½			6½	47		150			6¼	56

It appears that in the Savoys the heavier heads were from the small seed, while in the smooth cabbages the reverse was the case, and in the latter the heads from the large seed were also larger in diameter than from the small seed. The answer appears to be non-committal.

Seeds from different parts of the plant.

In the summer of 1884 we gathered seeds of three varieties of cabbage from the terminal pods of the main stem, and from the lower branches of the same, separately. The past season these were planted, and the plants of the different selections grown in adjoining rows. The number of plants of each, and the number, diameter and weights of the heads were as follows:

	From terminal pods.				From lower branches.			
	No. of plants	No. of heads.	Av. diameter of heads.	Average wt. of heads.	No. of plants.	No. of heads.	Av. diameter of heads.	Average wt. of heads.
Danish Drumhead	10	10	9 in.	74 oz.	12	12	9 in.	90 oz.
Excelsior	13	13	11 "	162 "	11	11	9 "	72 "
Duplicate	31	23	9 "	87 "	14	14	10 "	140 "
Marblehead Mammoth	8	7	10½ "	104 "	12	12	10½ "	140 "
Duplicate	20	10	9½ "	88 "	27	21	9½ "	104 "
Average	16⅖	12⅗	9⅘ "	105 "	15½	14	9⅗ "	129⅕ "

It appears that the seeds gathered from the lower branches yielded heavier heads in every case, than those from the terminal pods. We believe it has long been the custom with seed growers to reject the branches that grow out below the head. This experiment indicates that the pods from the lower branches of the main stalk are by no means inferior to those from the terminal shoot.

Green vs. Ripe Seed.

We grew a small number of plants of the Danish Drumhead cabbage from seeds gathered quite green. The heads grown from the green seeds averaged eight inches in diameter, and ninety-seven ounces in weight, while the average of four plantings from ripe seed, though about the same in diameter, gave a weight of only seventy-five ounces. These results accord with those obtained in 1884.

CAULIFLOWER.

Seeds of the following list of cauliflowers were planted in boxes in the green houses Mar. 30, and sixteen plants of each, with a few exceptions, were transplanted to the garden May 4th. The plants of Algiers and Le maitre pied court, were transplanted May 20, and those of the Wonderful, May 21. The soil was prepared as noted for the beet, and the plants were set in rows three and a half feet apart and eighteen inches apart in the rows.

As with the cabbage, the cabbage fly destroyed many of the plants, and though the rows were reset twice, there were still many vacant places.

The data noted are as follows:

Cauliflower.	First head formed.	Days from planting.	Number of plants.	Number of heads.	Av. diam. in inches.
Algiers	Aug. 24	147	22	19	7½
Alleume	Sept. 24	178	5	4	7
Autumn Giant	“ 24	178	17	17	7
d'Alger (Fr.)	“ 15	169	14	12	7½
Demi dur de St. Brieuc (Fr.)	“ 15	169	11	11	7
Early Dutch, or London (Fr. dur d'Hollande)	Aug. 25	148	12	8	5
Early Dwarf Erfurt (Thor.)	July 13	97	11	11	5½
Early Dwarf Erfurt (Vil.) (Fr. nain hâtif d'Erfurt	July 13	105	5	4	5½
Early London	Aug. 25	140	16	12	7½
Early Paris	July 25	109	11	6	5½
Early Picpus (Fr. hâtif de Picpus)	Aug. 5	128	12	10	8
Early Snowball	July 31	115	17	15	7
Extra Early Dwarf Erfurt (Hen.)	Sept. 27	181	18	8	6
Extra Early Dwarf Erfurt (Thor.)	July 13	97	12	11	5½
Extra Earliest Paris (Vil.)	Aug. 10	133	7	6	7½
Extra Early Paris	July 25	117	13	6	6½
Extra Selected Early Dwarf Erfurt	“ 1	93	13	13	5
Half Early Dwarf French	“ 25	112	12	7	7½
Half Early Paris (Thor.)	Aug. 14	137	12	11	6½
Half Early Paris (Vil.) (Fr. demi dur de Paris)	Sept. 15	169	11	11	7
Henderson's Early Snowball	July 8	100	12	9	7½
Imperial (Fr. Impérial)	Aug. 10	133	10	8	6½
Landreth's First	July 13	105	6	5	5½
Large Early London	Oct. 27	204	14	4	6
Large Late Asiatic (Fr. dur d'Angleterre)	Aug. 25	148	11	7	8
Late Giant Neapolitan (Fr. géant de Naples	Oct. 17	201	5	3	4
Late Paris (Fr. dur de Paris)	Aug. 12	135	10	7	7½
Late Stadtholders (Fr. dur de Stadthold)	Oct. 7	191	11	6	5½
Le Maitre piéd court (Fr.)	Aug. 14	137	15	13	7
Le Normand (Fr.)	Sept. 15	169	12	10	6½
Le Normandé Short Stemmed (Hen.)	Aug. 14	137	20	11	6
Le Normandé Short Stemmed (Vil.) (Fr. Le Normande à piéd court)	July 25	117	12	7	7
Purple Cape (Fr. noir de Sicilie)	Aug. 10	133	12	8	6½
Thorburn's Nonpareil	Aug. 14	137	7	6	8½
Veitch's Autumn Giant (Fr. Géant d'Autumn)	Sept. 24	178	13	11	7½
Walcheren (Hen.)	Sept. 1	155	4	4	7½
Walcheren (Vil.) (Fr. dur de Walcheren)	Aug. 5	128	6	6	7
Wonderful	Oct. 27	204	7	6	6

It appears that Henderson's Early Snowball (Hen. '85), was earliest, forming the first head July 8, or ninety-seven days from planting. It is to the credit of this variety that though earliest of all, the heads were rather above the average in size. The Extra Selected Early Dwarf Erfurt (Hen. '85) was second in earliness, and formed thirteen heads from thirteen plants, of which the average diameter was somewhat less than in the above.

Tha heads of Thorburn's Nonpariel (Thor. '83), averaged largest, or eight and a half inches in diameter.

Large vs. Small Seed.

As in the cabbage, we sifted the seeds of a few varieties, growing the plants from the larger and smaller seed separately, with the following result.

Cauliflower.	Large Seed.					Small Seed.				
	First head formed.	Days from planting.	Number of plants.	Number of heads.	Av. diameter in inches.	First head formed.	Days from planting.	Number of plants.	Number of heads.	Av. diameter in inches.
Algiers	Aug. 24	147	12	11	7	Sept. 15	169	10	8	8
Autumn Giant	Sept. 24	178	10	10	6½	" 24	178	7	7	7½
Early London	Aug. 25	140	7	5	6½	" 15	161	9	7	8½
Early Snowball	July 31	115	6	6	6	" 24	170	11	9	7½
Extra Selected Early Dwarf Erfurt	July 1	93	7	7	4½	Aug. 5	128	6	6	5½
Henderson's Early Snowball	July 8	100	3	5	7	July 20	112	6	7	6
Landreth's First	Aug. 6	129	2	2	7	" 13	105	4	3	7½
Lenormand's Short Stemmed	Aug. 14	137	10	8	6	Aug. 14	137	10	3	6
Walcheren (Hen.)	Sept. 1	155	3	3	6	Sept. 25	179	1	1	9
Average		133			6⅓		149			7⅓

The results are interesting, and suggestive. It appears that the plants from the smaller seeds produced heads that were on the average an inch larger in diameter, and about sixteen days later in maturing than those from the larger seeds. We shall endeavor to repeat this experiment the coming season.

BROCOLI.

We planted seeds from fifteen differently named packages of brocoli, in boxes in the cold-frame April 4th, and transplanted eleven plants of each to the garden May 22.

The plants made a most vigorous growth, in some cases attaining a height of three feet or more, but only three, viz. the Early Purple Cape, Thor., '85, Early White, Thor., '85, and Early Walcheren, Thor., '85 formed a head, and these but one or two each. It would appear that the brocoli has little value in our climate, as the past season was unusually favorable to other plants of the cabbage family.

LETTUCES.

Seeds of the following list of lettuces were planted in the garden April 24, in rows twenty-one inches apart and twelve feet long, one row to each name. The plants were thinned sufficiently as they increased in size to give those that remained an opportunity for complete development. The data noted are as follows :

	Of edible size, in days.	Commenced to head, in days	Com. to form flower stalk, ds.	Days fit for table use.	First bloom in days.	Last seeds ripe in days.
All the Year Round, b. s.	48	59	78	30	102	130
All the Year Round, w. s.	47	61	80	33	105	130
American Curled (Fr. Laitue frisée d'Amerique)	47	----	84	37	122	--
American Gathering	45	61	87	42	110	149
Balloon Cos	43	----	92	49	----	----
Bath Cos, b.s.	47	----	84	37	112	134
Bath Cos, w.s.	45	----	78	33	105	134
Black Seeded Simpson (Thor.)	45	59	84	29	115	144
Black Seeded Simpson (Sib.)	45	59	84	29	123	----
Black Seeded Satisfaction	43	57	75	32	97	127
Blood Red Small	45	65	77	32	98	144
Bloomsdale Butter, b. s.	50	57	77	24	102	144
Bloomsdale Early Summer	45	59	80	35	105	----
Bloomsdale Reliable	43	59	75	32	95	144
Bossin	45	61	82	47	122	----
Boston Market	49	56	66	17	89	112
Brown Batavian (Fr. Laitue Batavia brune)	45	----	84	39	115	156
Brown Dutch, b. s. (Fr. Laitue rousse Hollandaise)	45	63	77	32	97	144
Brown Dutch, w. s.	45	59	77	34	99	134
Brown Genoa, (Fr. Laitue Palatine)	48	59	61	13	77	112
Brown Winter (Fr. Laitue brune d'hiver)	48	59	63	15	84	113
Bruine Geel	48	57	65	17	85	125
Drumhead, or Malta (Fr. Laitue de Malte)	45	61	73	28	92	123
California Curled (Fr. Laitue frisée de Californie)	45	----	78	33	111	153
California Gardener's	45	----	84	39	108	134
Carter's Giant White	43	59	84	41	104	136
Carter's Giant White Cos	43	----	84	41	112	144
Common Green Cutting, w. s. (Fr. Laitue blonde à couper)	45	----	56	11	78	115
Commodore Nutt	47	57	75	28	99	113
Crisp German	45	59	78	33	104	134
Crisp Small Early, b.s. (Fr. Laitue crêpe à graine noire)	43	----	59	16	87	115
Crisp Small Early, w.s. (Fr. Laitue crêpe à graine blanche)	43	----	57	14	77	112
Crisp Small Early Cutting	47	----	57	10	82	112
Crisp Small Early Frame	48	----	59	11	87	110
Curled Beauregard (Fr. Laitue frisée à couper Beauregard)	48	----	82	34	110	144
Curled Cutting, b. s. (Fr. Laitue frisée a couper)	48	----	59	12	77	123
Curled German Batavian (Fr. Laitue Batavia frisée Allemande)	45	61	80	35	105	134
Deacon Hine	47	57	77	30	94	----
Deer Tongue	43	---	84	41	102	----
Dippe's Emperor	48	56	59	11	78	123
Dwarf Green Early, b. s. (Greg.)	48	56	69	21	92	123
Dwarf Green Very Early, b. s. (Fr. Laitue naine verte très hâtive)	47	56	70	23	87	125

	Of edible size, in days.	Commenced to head, in days.	Com. to form flower stalks, ds	Days fit for table use.	First bloom in days.	Last seeds ripe, in days.
Early Curled Silesian	45	----	82	37	99	144
Early Curled Simpson	47	----	84	37	103	144
Early Dwarf Brown Forcing	52	57	67	15	89	115
Early Egg Cabbage	52	59	73	21	95	134
Early Prize Head	47	61	84	37	102	144
Early Tennis Ball, or Boston	52	59	65	13	85	123
Everitt's Mammoth Market	52	----	84	32	102	144
Fine Early White Spring	55	----	67	12	89	125
Frankfort, b. s. (Fr. Laitue de Frankfort)	45	57	75	30	97	125
Frankfort Head	49	59	80	31	99	144
Georges	48	59	63	15	78	120
Giant White Cos	47	----	84	37	99	----
Golden Heart	47	70	77	30	102	144
Golden Spotted Head	55	67	80	25	102	----
Golden Stone Head	45	59	78	33	90	133
Green Dutch (Fr. Laitue monte à peine verte, à graine noire)	47	66	82	35	102	----
Green Fat (Fr. Laitue verte grasse)	47	67	80	33	108	144
Green Fringed (Sib.)	48	----	84	36	123	----
Green Fringed (Hen.)	52	----	89	37	123	----
Green Paris Cos	47	----	77	30	108	144
Green Royal Winter	52	----	84	32	99	144
Green Tennis Ball	48	57	59	11	87	127
Green Winter Cos	55	----	77	22	94	125
Green Winter, or Hammersmith (Fr. Laitue morine)	43	57	70	27	84	112
Green Winter of Naples	42	59	69	17	92	120
Grey Seeded Butter	47	61	78	31	99	144
Grey Paris	47	----	77	30	108	125
Grise	48	----	84	36	108	127
Ground Cos	52	----	70	28	85	120
Hanson (Thor. 83)	48	62	84	36	105	144
Hanson (Sib.)	47	62	84	37	105	144
Hardy Green Winter, or Hammersmith	55	----	75	20	90	112
Hardy Red Winter	48	61	67	19	87	115
Hubbard's Market	47	59	77	30	99	----
Ice Drumhead	55	----	84	29	108	134
Imperial	48	----	82	34	108	----
Improved Spotted Cabbaging	47	70	82	25	108	152
Improved Spotted Cos, b. s.	48	----	82	34	108	----
Improved Spotted Cos, w. s. (Fr. Romaine sanguine ameliorée)	45	----	84	39	97	144
India Head	52	----	73	21	97	144
Landreth's Earliest Cutting	48	----	73	25	92	133
Landreth's Forcing	47	56	77	30	105	144
Landreth's Heat Resisting Cos	47	----	77	30	97	132
Large Green b. s. (Fr. Laitue grosse brune paresseuse)	48	70	77	29	98	134
Large Green Pas-de Calais	47	----	77	30	97	144
Large Normandy (Fr. Laitue grosse Normande)	47	31	77	30	94	134
Large Versailles	52	----	89	37	113	156
Large White Stone Summer (Fr. Laitue grosse blonde paresseuse)	47	61	84	37	104	144
Large White Summer Cabbage	52	----	73	21	90	123
Large White Versailles (Fr. Laitue blonde de Versailles)	45	59	75	30	97	144
Large White Winter (Fr. Laitue grosse blonde d'hiver)	48	----	67	19	87	120

	Of edible size, in days.	Commenced to head, in days.	Com. to form flower stalks, ds	Days fit for table use.	First bloom in days.	Last seeds ripe in days.
Large Yellow Butter	45	63	77	22	99	133
Large Yellow Seeded Normandy	47	59	73	26	90	133
Leboeuf	47	----	77	30	104	144
Maderia, or Large Winter (Fr. Laitue Passion)	52	59	70	18	85	112
Magnum Bonum, or Florence Cos, b.s.	45	----	94	49	117	----
Magnum Bonum, or Florence Cos, w. s.	45	----	87	42	111	144
Milan, or Negro Head	46	59	77	31	99	144
Malta Drumhead	46	59	70	24	90	119
Malta Large Drumhead	45	59	66	21	77	125
Marvel or Red Besson (Fr. Laitue Merveille de quatre saisons)	45	59	82	37	111	----
Monstrous Brown Cos	43	----	84	41	102	125
Mortatella	45	57	61	16	82	116
Munson's Perfection	47	----	89	42	125	----
Neapolitan (Fr. Laitue chon de Naples)	42	63	77	35	104	---
Neapolitan Cabbage	45	59	82	37	111	144
New Orleans Cabbage	47	----	80	33	108	144
New Oak-Leaved	47	57	87	40	120	----
New Perpetual	45		84	39	105	144
New Premium Cabbage	52	57	80	28	99	144
New Silver Ball	47	61	84	37	125	----
New Stubborn Headed	47	59	75	28	102	144
O. K. Golden Head	45	59	73	28	94	134
Paris White Cos	47	----	90	43	134	----
Pas-de-Calais b. s. (Fr. Laitue paresseuse du Pas-de Calais)	43	----	77	34	94	144
Red Edged, or Victoria (Fr. Laitue à bord rouge)	47	57	66	119	84	144
Red Winter (Fr. Laitue rouge d'hiver)	43	59	61	18	77	144
Rochester Cabbage	47	59	77	30	97	----
Royal, or White Summer (Fr. Laitue blonde d'ètè)	45	59	77	32	105	134
Shotwell's Brown Head	47	59	87	40	124	----
Silver Ball New Winter	47	----	77	30	99	144
Speckled Dutch Butter Head Early Cabbage	45	61	67	22	82	144
Spotted Cos, w.s.	45	----	78	33	97	134
Stone Head Golden Yellow	49	59	73	24	98	----
Stone Tennis Ball, or Tom Thumb (Fr. Laitue gotte lente â monter)	42	59	66	18	88	116
Tennis Ball, b. s.	45		59	14	77	125
Texter	49	59	77	28	97	----
The Deacon	47	57	84	37	108	----
Trocadèro (Fr.)	45	59	77	32	105	134
Trout	47	62	77	30	99	144
Turkish or Butter (Fr. Laitue Turque)	45	69	80	35	102	----
Very Early Dwarf Green	47	57	70	23	97	125
Very Large Yellow Paresseuse	43	63	84	41	119	----
Victoria Cabbage (Sib.)	47	57	61	14	77	110
Victoria Cabbage (Thor. 1880)	47	59	77	30	98	127
Ward's Improved White Tennis Ball	47	57	66	19	84	120
White Batavian (Sib.)	46	----	84	38	105	144
White Batavian (Vil.) (Fr. Laitue Batavia blonde)	45	61	77	32	102	134
White Berlin Summer (Fr. Laitue blonde de Berlin)	45	67	73	28	94	132
White Boulogne (Fr. Laitue blonde de Boulogne)	45	----	57	12	77	110
White Chavigne (Fr. Laitue blonde de Chavigné)	45	57	84	39	124	144
White Nonpareil	47	61	70	23	92	127
White Paron (Fr. Laitue blonde de Paron)	45	61	77	32	97	134
White Seeded Satisfaction	45	61	73	28	92	132
White Tennis Ball	43	57	61	18	77	120

The time of forming the head is omitted in many varieties. The majority of these failed to form heads, though in a few cases the plants formed heads, but the time was not noted. It appears also that the date of complete maturity of the seed is sometimes omitted. In such cases the plants either blighted so badly that no seed ripened, or else the heads were so firm that the seed stalk seemed unable to burst its bonds.

Synonyms.

We have studied the plantings of lettuce with unusual care, with the hope of discovering, if possible, all the synonyms among them. The following appeared identical:

All the Year Round, b. s., Vil., '84, Bloomsdale Reliable, Land., '85, Black Seeded Satisfaction, Sib., '85, Frankfort, b. s., Vil., '85, Frankfort Head, Sib., '85, New Stubborn Headed, Far., '85, Texter, Ben., '83, and White Berlin Summer, Vil., '85.

All the Year Round, w. s., Vil., '84, Hubbard's Market, Sib., '85, New Premium Cabbage, Vick, '85, Rochester Cabbage, Sib., '85, Royal or White Summer, Vil., '85, and Everitt's Mammoth Market, Everitt, '85.

American Curled, Vil., '85, American Gathering, Thor., '85, and Early Prize Head, Sib., '85.

Bloomsdale Butter, b. s., Land., '85, Large Yellow Butter, Thor., '85, New Orleans Cabbage, Thor., '85, and Turkish or Butter, Vil., '85.

Boston Market, Hen., '84, Bruine Geel, Ben., '83, Red Edged or Victoria, Vil., 84, and Ward's Improved White Tennis Ball, Greg., '85.

Drumhead or Malta, Vil., '85, Ice Drumhead, Thor., '85, Malta Drumhead, Vil., '84, Malta Large Drumhead, Sib., '85, White Nonpareil, Carter, '83, and White Seeded Satisfaction, Sib., '85.

California Curled. Vil., '85, and Green Fringed, Sib., '85.

California Gardener's, Sib., '83, Large Green, Pas-de-Calais, Vil., '84, and Pas-de-Calais, b. s., Vil., '85.

Carter's Giant White Cos, Sib., '85, Giant White Cos, Sib., '83, Landreth's Heat Resisting Cos, Land., '84, and Paris White Cos, Sib., '83.

Crisp German, Sib., '83, and Curled German Batavian, Vil., '84.

Crisp Small Early Frame, Vil., '84, and Common Green Cutting, w. s., Vil., '85.

Curled Beauregard, Vil., '85, and Pelletier, Dam., '83.

Dwarf Green Early b. s., Greg., '84, Dwarf Green Very Early, b. s., Vil., '85, Landreth's Forcing, Land., '85, and Very Early Dwarf Green, Vil., '85.

Early Tennis Ball or Boston, Thor., '85, and White Tennis Ball, Sib., '85.

Grise, Sib., '83, and Brown Genoa, Vil., '85.

Hardy Green Winter or Hammersmith, Vil., '84, and Green Winter or Hammersmith, Vil., '85.

India Head, Thor., '85, and White Batavian, Sib., '85.

Large Versailles, Vil., '84, and Large White Versailles, Vil., '85.

Large Normandy, Vil., '85, and Large Yellow Seeded Normandy, Vil., '83.

Munson's Perfection, Sib., '83, New Perpetual, Till., '85, and Early Curled Simpson, Thor., '85.

Neapolitan, Vil., '84, and Neapolitan Cabbage, Vil., '85.

New Silver Ball, Till., '85, White Paron, Vil., '85, and Silver Ball New Winter, Dam., '83.

Tennis Ball, b. s., Vil., '85, and Green Tennis Ball, Vil., '84.

Very Large Yellow Paresseuse, Dam.,'83, and Large White Stone Summer, Sib. '85.

A Test with Green and Ripe Seed.

In order to note the influence of immature seed upon the resulting plants, we gathered a small quantity of green seeds of twelve varieties of lettuce in the fall of 1884. Last spring one row of each variety was planted with green, and a second with ripe seeds gathered from the same plants. No difference appeared in the resulting crop that we could assign to the maturity or lack of maturity of the seed.

Lettuce.

A DESCRIPTION OF THE PRINCIPAL VARIETIES.

We have endeavored to acquaint ourselves with the principal varieties of lettuce grown in this country and in Europe, with the view of determining the synonyms, and forming an accurate and complete description of each distinct variety. The undertaking is a difficult one for three reasons. 1st, The number of varieties is quite large. 2nd, In many cases the same name has been applied to two or more different varieties, and 3d, the descriptions that have been made of lettuces are, with a few exceptions, so meagre that they have proved of very little assistance. We must here further acknowledge our indebtedness to our French friends, Messrs. Vilmorin, Andrieux & Co., of Paris, whose descriptions of varieties of vegetables are by far the most complete of any that we have thus far met.

It is not to be supposed that we have grown all of the varieties of lettuce at present in culture in Europe and America. Our aim has been to grow all those mentioned in our own catalogues, with as many from France and Germany as we could readily obtain.

The eighty-seven varieties which we describe with the supposition that they are distinct, have been gleaned from a list of at least two hundred differently named lettuces, and represent the labor of three seasons. The list does not include all that we have grown, but only those of which we at present feel satisfied are distinct.

We scarcely hope that the classification and descriptions which we here present will enable one unacquainted with the characters of the lettuce plant to name a given variety with ease and certainty. The most we dare to hope is, that with the help of these, it may be possible to decide with some degree of certainty whether or not a given lettuce is true to the name which it bears. If we have accomplished this much, our work will not have been in vain.

The difficulties of arranging a scheme for determining varieties through a system of classification and description, will readily appear when we consider the fact that the lettuce plant varies greatly at different stages of growth, under different systems of culture, and at different seasons of the year. For example, the leaves of the young plant often differ materially in form, and other characters from those of the same variety when the plant has matured. Varieties easily distinguishable when the plants are grown sufficiently far apart, so that each one has opportunity to assume its own character, will often be undistinguishable when the plants are crowded. And finally, many varieties which, if the seed is sown in spring will form large and well defined heads, will run to seed without heading if the seed is sown a few weeks later. We believe that our descriptions will only apply when the plants are grown under conditions similar to those which we have observed, and which we will here delineate.

It has been our custom to sow the seed of all the varieties as early as possible in spring, in rich soil, in rows either twenty-one inches apart, or twice that distance, thinning the plants as they began to crowd each other, to at first six inches apart in the row, and later to remove every alternate plant, thus leaving the full grown plants one foot apart in the row. Grown in this way, the plants have full opportunity to develop their individual characters. We have reasons for believing that the varieties of lettuce grown under equal conditions are remarkably constant.

The descriptions have all been made from plants in the garden, and when possible our own notes have been compared with the descriptions of Vilmorin, or Burr, or both these authors. It has been our endeavor to make the descriptions more complete than any heretofore made. We have attempted to describe particularly the portions which constitute the distinguishing characters of the varieties; but in many cases these are so few, or the differences which they represent are so obscure, that we have found no other recourse than to give careful descriptions of all the visible characters.

In the choice of names for the varieties described we have aimed at brevity and distinctness. We have carefully avoided the use of any name that would be likely to cause confusion with the name of any other variety. This has necessitated changing in a few cases the name under which the variety has been generally known, substituting a synonym that does not tend to confusion. We have in no case coined a name.

We have taken especial pains to give French and German synonyms, when these could be obtained. As is well known, much of the lettuce seed used in this country is imported from France and Germany. Hence we regard an international list of synonyms as of great value in preserving a uniform system of names. For the German synonyms used, we are indebted principally to Messrs. Vilmorin, Andrieux & Co.

Explanation of terms used in describing varieties.

The words used in describing the form and outline of the leaves have precisely the same signification as in Botany. In lettuce, however, the surface of the leaf furnishes several distinguishing characters, dependent upon the degree of smoothness, etc., the clear expression of which necessitates the use of a few words not employed in botanical descriptions. These we will endeavor to explain.

We distinguish between *margin* and *border*, as applied to the leaf, restricting the former to the line describing the contour, and the latter to that part of the blade adjacent to the margin.

In many varieties of lettuce the border is more developed than the rest of the leaf, which causes this part to become more or less waved. When the ridges and depressions thus formed are but slight, as in the Spotted Cos lettuce, we have called the border *undulate;* when, however, they are very strongly marked, so that the depressions are nearly or quite as deep as broad, as in the Curled Simpson lettuce, we have called the border *ruffled.* A border that is neither undulate nor ruffled is called *plain.*

In many varieties the part between the veins is developed in excess of the veins, which causes this part to puff out, forming elevations or depressions. Such leaves are called *blistered.* In some, the lower part of the leaf has numerous oblong blisters extending parallel to each other, and nearly or quite at right angles to the midrib. Such leaves we have called *puffed.*

When the whole leaf is somewhat twisted or contorted, we have called it *waved;* when the midrib curves downward in the centre, so that the leaf is concave, we have called it *spoon form.* When the midrib curves upward, making the upper surface of the leaf convex, we have called it *inversely spoon form.*

When the leaves of a young plant of lettuce are all curved in the same direction like the wings of a turbine wheel, or a paper wind mill, we have called the plant *wheel-form.*

In some varieties the outer leaves of the head are so formed that they curve inward at the top as far as, or farther than, the centre of the head, so that each leaf represents nearly a hemisphere. Such leaves have some resemblance to a hood upon the head, and hence in want of a better term we have called them *hood-shaped.*

In a few varieties, in which the foliage is very compact, the outer leaves curve downward, overlapping each other something like the shingles upon a roof. We have called such plants *shingled.*

As the different varieties of lettuce bloom, a rather marked difference appears in the form of the flower head. In some this is compact and nearly flat on the top more or less resembling the corymb; in others it is long and loose, more like the panicle. In our descriptions we call these heads which resemble the corymb more than the panicle, *corymbose;* and those that resemble the panicle more than the corymb, *paniculate.*

In the stem leaves of most varieties of lettuce more or less prominent lobes extend beyond the point where the midrib attaches to the stem. These lobes we have called *ears.*

We append the authority for each name or synonym used.*

When the authority is printed in italics with a date, it indicates that we have grown such variety or synonym from seed obtained from the party named, and in the year specified. Example. In the first variety described—the Berlin lettuce—we have grown the synonym All the Year Round, b. s., from seed from Vilmorin, Andrieux & Co., in 1884, and from Hiram Sibley & Co., in 1885.

Synonyms determined or verified by ourselves are printed in italics. Synonyms determined by comparing plants, or our own notes with the descriptions of others, have "(d)" appended immediately after the name. Synonyms that have been claimed by others, but which we have not verified have only the authority appended.

The letters "b. s.," "gr. n.," or "s. k.," stand for "black seed," according to the language in which the name or synonym is given. In like manner, the letters "w. s.," "gr. bl.," or "w. k.," stand for "white seed."

Arrangement of the varieties.

In the arrangement of the varieties, we follow the plan adopted in Les Plantes Potagères, viz. that of separating them into three classes, designated as Cabbage, Cos and Cutting lettuces. This classification is but partially founded upon botanical characters, and is here employed purely for convenience. It seems probable from the varieties which we have grown that a strictly botanical classification may at some future time be made.

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*For explanation of the abbreviations used, see list given at the close of the introduction to Report of the Horticulturist.

Cabbage Lettuces.

The varieties of this class are distinguished in having roundish, or but slightly oblong leaves, which are more spreading than upright. Nearly all form more or less clearly defined roundish heads when grown under favorable conditions. In this class the leaves of the full grown lettuce are never plain, but invariably more or less puffed or blistered or both.

Cos Lettuces.

These differ chiefly from the cabbage lettuces in having distinctly oblong leaves, which incline to grow upright. In general their leaves are thicker than those of the cabbage class, have larger and more rigid midribs and veins and have the surface more nearly plain. Many of this class form oblong, loose heads, either of themselves, or when the leaves are tied together.

In a few varieties the characters seem about equally balanced between the cabbage and cos classes, but of those that we have grown, the majority may be very readily referred to the proper class from the above definitions.

Cutting Lettuces.

The separation of this class seems to be purely artificial, as it includes varieties of which the leaves resemble both those of the cabbage and of the cos lettuces. The distinction is that the varieties of this class do not form heads, but furnish instead a vigorous growth of leaves which grow again after being cut off. In the earlier stages of growth the varieties of this class are not distinguishable in appearance from those of the other classes.

ANALYTICAL KEY.

As an aid in identifying the varieties, we present a brief analytical key, by which a given lettuce may be referred to a comparatively short list, from which we think it may generally be readily named.

1. Leaves roundish, or but slightly oblong; spreading, rather than upright.
   A. Borders of leaves plain or nearly so.
   * Foliage green. Nos. 1, 2, 10, 12, 14, 15, 16, 17, 21, 23, 24, 25, 26, 28, 29, 30, 32, 34, 35, 37, 42, 46, 51, 53, 55, 56, 57, 59, 60, 63, 64, 65, 85.
   ** Foliage more or less tinged or spotted with red, brown or purple. Nos. 4, 7, 8, 9, 11, 19, 22, 33, 39, 41, 44, 45, 48, 49, 50, 52, 58, 62.
   B. Borders of leaves distinctly ruffled.
   * Foliage green. Nos. 3, 13, 18, 20, 27, 31, 36, 38, 40, 43, 83.
   ** Foliage more or less tinged or spotted with red, brown or purple. Nos. 5, 6, 47, 54, 61.
2. Leaves oblong, tending to grow upright.
   A. Leaves oval or spatulate.
   * Foliage green. Nos. 66, 67, 68, 72, 73, 74, 75, 76, 77, 82, 84.
   ** Foliage more or less tinged or spotted with red, brown or purple. Nos. 70, 71, 78, 79, 80, 81.
   B. Leaves lanceolate. No. 69.
3. Leaves pinnately lobed. Nos. 86, 87.

CABBAGE LETTUCES.

No. 1. BERLIN, VIL.

Synonyms: *All the Year Round*, b. s., *Vil.*, '84, *Sib.*, '85; Berlin White Summer, Vil.; *Black Seeded Satisfaction*, *Sib.*, '84; Black Seeded Yellow, Vil.; *Bloomsdale Reliable*, *Land.*,'84; Fine Imperial Cabbage, Vil.; Imperial Cabbage, Vil.; Leyden White Dutch Cabbage, Vil.; *Salamander*, *Hend.*, '83; Royal or White Summer, Chis. trial; Satisfaction Black Seeded, Vil.; *Texter Ben.*, '84; *White Berlin Summer*, *Vil.*, '84; Fr. Laitue blonde à gr. n., Vil.; *L. blonde de Berlin*, *Vil.*, '85; L. blonde de Tours, Vil.; L. royale à gr. n., Vil.; GER. Berliner gelber Kopf-Lattich, Vil.; Grosser gelber Berliner Lattich, Vil.; Grosser gelber Berliner Königs Kopf. L. s. k. (d.), Dam.

Young plant pale green, compact, sometimes wheel form; leaves roundish, apex retuse, outer ones nearly smooth, slightly waved, borders of inner leaves somewhat undulate, surface more or less puffed and blistered; midribs almost concealed in the compact foliage.

Mature plant clear green, with a slight lustre, ten to twelve inches in diameter; head well defined, globular, compact, sometimes five inches in diameter, of which the inner leaves are pale yellowish green, or cream color, outer leaves of the head scarcely meeting at the top, usually folding back a little at the apex, growing nearly perpendicular, and when the head is fully formed, disclosing rather conspicuously their lower surfaces; leaves about the head very large, coarsely waved, slightly spreading, densely puffed and blistered; stem smooth, corymbose; seeds black.

A superior variety for early out-door culture. It heads well in dry weather, is slow in running to seed, and succeeds upon almost all soils. The flavor continues good until the flower stalk appears.

Figured in Album de clichés.

As All the Year Round, introduced in 1868, Gard. Chron., 1869, 1850; as Fine Imperial Cabbage or Berlin, in the U. S. in 1854, Browne; Black seeded yellow of Thomp., 1850; Blonde de Berlin of Hort. Fran., 1824.

No. 2. BLACK SEEDED GOTTE, *Vil.*, '85.

Synonyms: Early White Spring, Burr.; *Fine Early White Spring*, *Vil.*, '84; White Gotte, b. s., Vil.; FR. *Laitue gotte à graine noire*, *Vil.*, '85; L. roulette, Vil.; GER. Früher gelber kleiner stein Kopf-Lattich, Vil.

This variety differs little from the Tennis Ball, w. s. except in the color of its seeds, The leaves are rather more waved and blistered, and the whole plant is a little smaller. The head is slightly depressed, never very firm; stem slender, smooth, corymbose; seeds black.

Useful for frame culture, but of little value out of doors. Unless planted very early it heads poorly, and quickly runs to seed.

Figured correctly in Dybowski, Traité de cult. pot., p. 316.

No. 3. BLACK SEEDED SIMPSON, *Sib.*, '83, *Thorb.*, '85.

The young plant closely resembles that of Early Simpson, though a shade paler in color.

Mature plant twelve or fourteen inches in diameter, distinguishable from Early Simpson by its paler color, larger size, and dull aspect, lacking the lustre of the latter. The head is not well defined, though large and compact; the leaves forming it curve outward at the top, exposing those below, which seem crowded together in disorder; head three inches in diameter, about four inches tall, whitish green within; stem smooth, often a little flattened, paniculate, stem leaves very numerous, pointing outward, very pale green with very prominent ears; seeds black.

This variety is early, slow in running to seed, and excellent in quality.

No. 4. Blood Red Small, *Ben.*, '84.

Synonym: Blood Red (d.), Chis. trial.

Young plant much washed with dark purplish red; leaves oval, inclining to spatulate, apex retuse, outer leaves somewhat waved, borders of inner leaves slightly undulate, surface nearly or quite smooth, midribs pale green, more or less tinged with purple, veins inconspicuous.

Mature plant about twelve inches in diameter; leaves where most exposed to light very deep, almost blackish red; forms a rather large, loose head about two and a half inches in diameter, and three inches tall, of which the inner leaves are whitish green, slightly spotted with brown, outer leaves of the head nearly perpendicular, turning out a little at the apex, where they are tinged with red; stem smooth, somewhat washed with purplish red, paniculate, stem leaves deep purple towards the top; seeds black.

Rather late in maturing the head, which is not long retained.

No. 5. Bossin, *Greg.*, '83, *Vil.*, '84.

Synonyms. New Summer Cabbage, Vil. ; The Favorite, Vil. ; Very Large Bossin, Vil.; Fr. *Laitue Bossin, Vil.*, '84; L. Bossin trés grosse, Vil.; Ger. Allergrösster rothgelber Bossin Kopf Lattich, Vil.; Bossin's Reisen, w. k. (d.), Dam.

Young plant very vigorous, pale green, the inner leaves somewhat tinged with copper red, leaves roundish or oval, finely, often doubly erose dentate in the lower half, obscurely dentate above ; borders strongly ruffled, in a scalloped outline, the apexes all pointing upward. As the plant increases in size, the leaves are considerably blistered, but not puffed; veins rather conspicuous.

Mature plant fourteen inches or more in diameter ; outer leaves coarsely waved, slightly blistered, but not puffed, inner leaves thickly covered with small wart-like prominent blisters; head very large, but very loose, the outer leaves of it completely folding over the top, sometimes reaching an inch or more downward, inner leaves slightly washed or spotted with reddish brown on the borders and more exposed blisters; stem smooth, often a little flattened, somewhat washed with purple, paniculate, stem leaves numerous, half erect; seeds black.

A hardy variety of immense volume, which stands the heat well, and is of good quality. Its very large size is objectionable to some, as it must be given plenty of room and hence is not very suitable for growing between the rows of other crops.

Figured correctly in Les pl. pot., p. 304.

No. 6. BROWN BATAVIAN, *Vil.*, '84.

Synonyms. Brown Silesian, Vil. ; Marsailles Cabbage, Vil. ; Fr. *Laitue Batavia brune, Vil.*, '85; L. brune de Silésie, Vil.; L. chou, Vil.; Ger. Brauner Marsailler Lattich, Vil.

Young plant very deep green, the dark veins and midribs giving it a brownish cast; leaves broadly ovate spatulate, borders rather finely ruffled, apex usually pointing upwards, surface of outer leaves slightly, of inner ones more blistered, veins conspicuous, leaves quite thick.

Mature plant very large, sometimes eighteen inches in diameter, of a very peculiar bronze green ; leaves compact, numerous, borders of inner ones tinged with dark brown, surface finely but sparsely blistered, (innermost leaves densely blistered), but never puffed ; midribs bordered with brown; head very tall, oblong, resembling a head of Cos lettuce, rarely well formed; exterior leaves very large, at first erect, then curving outward; stem nearly smooth, very often flattened, much washed with purple, paniculate; stem leaves numerous, half erect, with very large ears; seeds white.

"A hardy, late sort ; retains its head a long period; better when cooked than when served in its raw state." "Esteemed in warm countries." Vil.

Correctly figured in Les pl. pot., p. 303.

No. 7. BROWN DUTCH, b. s., *Vil.*, '84, Ferry (d), '84.

Synonyms: Black Seeded, Burr; FR. Laitue grosse hollandaise, Vil.; *L. rousse hollandaise, Vil.*, '85; GER. Brauner holländischer Kopf-Lattich, Vil.; Brauner Zarter Holländischer L., Vil.

Young plant rather dark, dull green, rather low and spreading ; borders of inner leaves faintly tinged brown, leaves roundish or oval, sometimes inclining to spatulate, apex entire or retuse, borders scarcely undulate, inner leaves blistered, slightly folded upon the midrib, which is nearly white, sometimes faintly tinged with brown; veins slightly sunken, not very conspicuous.

Mature plant ten to twelve inches in diameter, variable in color, in some plants reddish brown, in others greenish brown; forms a compact, but poorly defined head about three inches in diameter, the leaves of which are much contorted, yellowish green, except where fully exposed to light; leaves surrounding the head curve outward at the apex; stem smooth, strongly tinged with reddish purple, paniculate; stem leaves half erect.

The head is slow in forming, and is moderately well retained, but often becomes bitter before the flower stalk appears. The plant much resembles that of Palatine but differs from it in the absence of spots upon the leaves, and being a little less washed with brown.

Figured correctly in Les. pl. pot., p. 300.

This is an old variety, and is named in M'Mahon's American Gardener's Calendar, 1806, and by succeeding writers in 1818, 1819, 1821, .828, 1835, 1854, etc.

No. 8. BROWN DUTCH, *w. s.*, *Vil.*, '84.

Synonyms: Bigotte, Chis. trial.; *Laitue monte à peine à gr. bl.*, *Vil.*, '84; L. rousse hollandaise à gr. bl., Vil.

Young plant dark dull geen, borders of inner leaves faintly tinged brown; leaves oval, inclining to spatulale, apex entire or retuse, borders scarcely undulate, leaves often somewhat folded upon the midrib which is faintly tinged with brown, especially below, surface of inner leaves blistered; veins slightly sunken, not very conspicuous.

Mature plant ten to twelve inches in diameter; leaves faintly tinged with brown where most exposed to light; forms a rather compact, not very clearly defined head about three inches in diameter, four inches tall, of which the outer leaves grow nearly perpendicular; outer leaves coarsely blistered and puffed, blanched toward the base. The head, of which the leaves are greenish yellow, becomes bitter before the flower stalk appears; stem smooth, strongly washed with reddish purple, paniculate; stem leaves half erect.

Mentioned by Buist in 1851, and by Brown in 1854.

No. 9. Brown Winter, *Vil.*, '84.

Synonyms: Brown Winter Cabbage, (d.), Burr.; Large Brown Winter Burr.; Fr. *Laitue brune d' hiver, Vil.*, '84; L. grosse brune d'hiver, Vil.; Ger. Brauner Winter Kopf-Lattich., Vil.

Young plant rather spreading, sometimes inclining to wheelform; leaves more or less washed with dark purplish red, the inner ones more deeply colored; leaves roundish or oval, apex retuse, borders of inner leaves undulate, surface blistered, outer leaves strongly waved, with coarsely undulate borders.

Mature plant compact, seven to ten inches in diameter; leaves more or less spoonform, outer ones nearly smooth; head roundish, rather solid, composed of, and surrounded by leaves, having rather large blisters. The whole plant inclines to wheelform, and the leaves are much washed with brown; stem short, smooth, compact, corymbose; seeds white.

Grown as a spring lettuce this variety formed no head, and early ran to seed.

Figured correctly in Les. pl. pot., p. 289.

No. 10. Butter, *Vil.*, '84.

Synonyms: Asaitic, Vil.; *Black Seeded Butter, Hend.*, '84; *Bloomsdale Butter b.s., Land.*, '84; Large Butter Head, Vil.; *Large Yellow Butter, Thorb.*, '85; *New Orleans Cabbage, Thorb.*, '85; Russian or Butter, Vil.; Turkey Cabbage, Vil.; *Turkish, Vil.*, '84; Fr. Laitue d' Alger à gr. n., Vil.; L. grosse, Vil.; L. grosse Allemande, Vil.; L. incomparable, à gr. n., Vil.; L.de Russie, Vil.; *L. Turque, Vil.*, '85, (d.), L., hort. Fran; Ger. Gelber Asiatischer Lattich, s. k., Vil.; Grosser Westindischer L. Vil.

Young plant dull pale green, low and spreading; leaves roundish or oval, finely and sharply, often doubly erose dentate towards the base, obscurely dentate in the upper half, apex entire; outer leaves slightly waved, inner ones somewhat blistered; veins sunken conspicuous.

Mature plant about twelve inches in diameter, spreading; the outer leaves lying upon the ground, very large, roundish, coarsely blistered and puffed, pale green, and of an appearance suggesting great thickness; forms a well defined compact head about four inches in diameter, and three inches tall, flattened on the top, where the leaxes do not meet; leaves aboutthe head nearly perpendicular, the apex pointing outward; stem smooth, paniculate, sometimes inclining to corymbose; stem leaves pointing outward; seeds black.

An excellent summer variety, enduring heat and dryness well, forming the head with much certainty, and very slow in running to seed.

Figured correctly in Carson's Seed Catalogue, 1881.

No. 11, CALIFORNIA GARDENER'S, *Sib.*, '83.

Synonyms: *Large Green Pas-de-Calais, Vil.*, '84; FR. *Laitue paresseuse du Pas-de-Calais, Vil.*, '85; L. julienne d'été, Vil.

Young plant rather deep clear green, borders of inner leaves often tinged with brown; leaves roundish or oval, approaching spatulate, obscurely dentate in the upper half, apex entire or retuse, borders scarcely undulate, outer leaves nearly smooth, inner ones puffed and blistered, often somewhat folded on the midrib; veins not conspicuous.

Mature plant about twelve inches in diameter, dull green, borders scarcely washed with brown; forms a moderately compact, not very well defined, roundish head about three inches in diameter, of which the outer leaves are nearly perpendicular, and densely puffed and blistered, head greenish yellow within; outer leaves of the plant curving downward, coarsely puffed and blistered; stem smooth, much washed with reddish purple, paniculate; stem leaves half erect; seeds black.

No. 12, COMODORE NUTT, *Ben.*, '83.

Young plant pale yellowish green, leaves oval or roundish, apex retuse, surface of inner leaves puffed and blistered, and their borders undulate, veins rather conspicuous.

Mature plant about ten inches in diameter, four or five inches high, very compact, rather spreading, pale green, slightly glossy, borders sometimes inclining to yellow; head not defined, composed of short very densely blistered leaves, very compactly crowded together in apparent confusion, butter color within; outer leaves nearly horizontal, waved, in some plants distinctly shingled, rather densely blistered; stem smooth, paniculate; seeds white.

This variety is rather early, and quite slow in forming the seed-stalk. It was described as a novelty by Bliss in 1878.

No. 13, CRISP GERMAN, *Sib.*, '83.

Synonyms: *Curled German Batavian, Vil.*, '84; FR. *Laitue Batavia frisée Allemande, Vil.*, '85; L. Batavia italienne, Vil.; GER. Grüner früher Montrée Lattich, Vil.; Krauser Deutscher Kopf-Montrée Kopf-L., Vil.

Young plant pale yellowish green; leaves roundish, border finely ruffled, surface of outer leaves nearly smooth, of inner ones blistered, midribs narrow, not conspicuous, veins much depressed.

Mature plant about twelve inches in diameter, very pale green, inclining to yellow in places; leaves waved, densely and finely blistered, but not puffed; forms a small, not well defined head, of which the leaves are distinctly hood-shaped; outer leaves glossy; stem smooth, corymbose; stem leaves usually pointing downward, ears large; seeds white.

Figured correctly in Les pl. pot., p. 302.

No. 14, CRISP SMALL CABBAGE, *Vil.*, '84.

Synonyms: Crisped Small Cabbage, Vil.; *Crisp Small Early, b. s., Vil.*, '84; FR. *Laitue crêpe à gr. n., Vil.*, '85; L. crêpe hâtif, Vil.; L. crêpe petite, Vil.; L. petite crêpe, Vil.; L. petite noire, Vil.; GER. Früher gelber Kleiner Stein Kopf-Lattich, s. k., Vil.; Früher gelber Stein Kopf-L., Vil.

Young plant pale, almost whitish green, inclining to wheelform; leaves roundish, but with an angular outline, obscurely dentate in the upper half, apex entire or retuse, outer leaves nearly smooth, inner ones much blistered, with undulate borders.

Mature plant seven or eight inches in diameter, somewhat glossy, inclining to wheelform; forms under favorable conditions a small, rather loose head; stem tall, branching low, smooth, corymbose; seeds black.

Very popular in France for earliest frame culture; little grown in this country.

Figured correctly in Les pl. pot., p. 290.

Described in L'hort. Fran. 1824, by Petit in 1826 and Noisette in 1828.

No. 15, CRISP SMALL EARLY, W. S., *Vil.*, '85.

Synonyms: Yellow Egg Frame, *w. s.* (*d.*), *Dam.*, FR. *Laitue crêpe à gr. bl., Vil.*, '85; L. crêpe blonde, Vil.; GER. Früher gelber Eier salat, Vil.

Young plant pale yellowish green, distinctly wheelform; leaves roundish spatulate, sometimes oblong, erose dentate in the lower two-thirds, sinuate in rest of outline, border slightly undulate, apex nearly entire, surface of outer leaves strongly waved, slightly puffed and blistered, inner leaves much puffed and blistered.

Mature plant rather loose and open, about ten inches in diameter, very pale yellowish green; does not usually form a head unless the plants are a little crowded; head medium, rather tall, formed of leaves that are paler and much more blistered than the outer ones, which are strongly waved; stem tall, corymbose.

This variety is very early, but soon runs to seed in this climate when grown in the open ground.

No. 16, DEACON HINE, *Fer.*, '85.

Synonym: Ice (d.), Fer.

Young plant very deep, dull green, often inclining to wheelform; leaves roundish, apex retuse, surface much puffed below, but nowhere blistered, inner leaves often spoonform; veins slightly sunken, not very conspicuous.

Mature plant remarkably compact, spreading, deep glossy green, about ten inches in diameter, four or five inches tall; forms no defined head; inner leaves short, very much crowded together, densely crumbled, all except the most central ones pointing outward; outer leaves much puffed but very little blistered, sometimes shingled; stem rather short, often flattened, somewhat striate, paniculate; seeds black.

The leaves are very thick, mild and tender. The plant is not very rapid in development, but quite slow in running to seed.

No. 17, Dippe's Emperor, *Dam.*, '83.

Young plant rather pale green, very compact, often inclining to wheelform; leaves roundish or oval, apex very distinctly retuse, outer leaves waved, surface of all leaves more or less puffed and blistered; veins not conspicuous.

Mature plant five to eight inches in diameter, very compact, forming a firm head about two inches in diameter, the outer leaves of which curve outward at the apex; outer leaves of the plant much blistered; stem slender, rather short, broadly corymbose; seeds black.

A very early lettuce, well adapted for forcing.

No. 18, Early Curled Silesian, *Sib.*, '83.

Synonyms: Curled Silesian (d.), Hend.; Fr. Laitue hâtive de Silésie, Vil.

Very closely resembles the Early Simpson lettuce. The leaves are a little less waved, and not quite so yellowish; the whole plant is a little less compact; but the most conspicuous difference is that the mature plant is more open in the center, forming little appearance of a head. The stem is rather less paniculate; seeds white.

Mentioned by Fessenden in 1828, and described by Brown in 1854.

No. 19, Early Dwarf Brown Forcing, *Ben.*, '83.

Young plant pale green, washed with brown; leaves roundish or oval, apex retuse, margin of inner leaves somewhat undulate, surface of all more or less blistered, of inner ones puffed and densely blistered; veins inconspicuous.

Mature plant seven inches in diameter, the densely blistered leaves much washed with reddish brown; head small, oblong, one and one half inches in diameter, the inner leaves very much, and very finely puffed, the outer leaves of the head curving outward at the apex; borders of leaves, usually undulate; stem short, slender, smooth, corymbose; seeds white.

Of little value except for forcing, or earliest culture in open ground.

No. 20. Early Simpson, *Vil.*, '85.

Synonyms: *Curled Simpson, Batch.*, '82; *Early Curled Simpson, Vil.*, '84, *Thorb.*, '85; *Munson's Perfection, Sib.*, '84; Nellis' Perpetual, (d.), Nellis; *New Perpetual, Till.*, '85; *Perpetual*, Bliss, '83; Simpson's Early Curled, Vil.; Simpson's Silesia's, (d.), Brill; Fr. Laitue Allemande, Vil.; L. á couper frisée d' Australie, Vil.; L. glacée, Vil.; *L. hâtive de Simpson*, Vil., '85; Ger. Gelber Simpson Lattich, Vil.; Grosser gelber Simpson Kopf-L., Vil.

Young plant pale yellowish green; leaves roundish, borders finely ruffled, surface of outer leaves nearly smooth, of inner ones much puffed and blistered; veins conspicuous.

Mature plant twelve inches in diameter, six or seven inches tall, compact, very pale yellowish green, borders of inner leaves golden green; does not form a well defined head, though the inner leaves are closely crowded together; those about them curve outwards and are very densely puffed and blistered; outer leaves densely, but more coarsely puffed and blistered; veins inconspicuous; stem tall, often striate, sometimes flattened, paniculate; stem leaves numerous, pointing outwards, smooth only near the top, ears prominent, pointed; seeds white.

A very popular variety, largely grown in frames and for open crop about New York City. It is very early and very slow in running to seed; quality excellent, the leaves being very crisp, tender and brittle.

Probably a selection from the Curled Silesian; said to have originated near Brooklyn, N. Y.

Figured fairly correctly in Les pl. pot. p. 302.

No. 21. GEORGES, *Vil.*, '84.

Synonyms: FR. *Laitue Georges*, Vil.,'84; L. George blanche, (d.), Noisette.

Plant pale green, leaves roundish, borders entire except towards the base, apex entire or retuse, surface of inner leaves puffed and blistered.

Mature plant about six inches in diameter; forms a rather compact, but poorly defined head of which the inner leaves are folded in apparent disorder, and of which the outer leaves curve back at the apex; outer leaves coarsely blistered, waved, or folded on the midrib; stem slender, smooth, corymbose; seeds white.

The head is slow in forming, and not long retained. This variety is of little value except as a cutting lettuce, but is grown as a forcing lettuce by the Paris market gardeners.

No. 22. GOLDEN SPOTTED, *Ben.*, '83.

Synonyms: *Golden Spotted Head, Farquhar*, '85; New Golden Spotted, (d.), Till.

Young plant greenish yellow, inclining to wheel form, densely mottled with chocolate brown; leaves oval, inclining to spatulate, apex entire or very slightly retuse, surface of outer leaves nearly smooth, inner ones puffed and slightly blistered, with undulate borders; midribs greenish white, splashed with red or brown, veins almost invisible.

Mature plant about ten inches in diameter, six inches high, presenting a beatiful mingling of brownish red and pale green; forms a small roundish head two to three inches in diameter; leaves puffed and blistered, margins undulate; stem short, smooth, tinged with purple, paniculate; stem leaves pointing outward, spotted to the top, but less golden than in the young plant; seeds white.

A superior summer lettuce. The head is slow in forming, but is retained a long time, and is very tender and mild. The plants stand the heat very well.

No. 23. GOLDEN STONE HEAD, *Thorb.*, '82.

Synonyms: *O. K. Golden Head, Everitt*, '85, *Rochester Cabbage, Sib.*, '85.

Young plant pale yellowish green, usually somewhat wheelform; leaves roundish or ovate spatulate, apex retuse, outer leaves strongly waved, often puffed towards the base, inner leaves much puffed, slightly blistered.

Mature plant compact, ten to twelve inches in diameter, about five inches high; forms a compact but poorly defined head two and a half to three inches in diameter, of which the leaves are densely puffed and blistered, and crowded together in apparent disorder; leaves about the head nearly perpendicular, curving outward at the apex; outer leaves slightly waved, curving downward, coarsely blistered; stem tall, smooth, corymbose; stem leaves pointing outward; seeds white.

Of excellent quality, heads promptly, and is rather slow in running to seed.

No. 24. GRAY SEEDED BUTTER, *Thorb.*, '83.

Synonyms: *Bloomsdale Early Summer, Land.*, '84; *Large Yellow Butter, gray seed, Thorb.*, '85; *Yellow Seeded Butter, Hend.*, '83.

Young plant pale, slightly yellowish green, rather low and spreading; leaves roundish or oval, apex entire or retuse, surface of outer leaves nearly smooth, of inner ones puffed and blistered.

Mature plant about twelve inches in diameter, compact, spreading, forming a roundish compact head three inches in diameter, of which the outer leaves curve inward sufficiently to expose their lower surface, usually recurving a little at the apex; head yellowish green within; leaves surrounding the head rather coarsely puffed and blistered; stem smooth, paniculate; seeds yellowish or grayish.

Rather late in forming the head, but slow in running to seed. Of excellent quality.

No. 25. GREEN DUTCH, *Vil.*, '84.

Synonyms: FR. *Laitue monte à peine verte à gr. n.*, Vil., '85; GER. Grüner monte á peine Kopf-Lattich, Vil.

Young plant very deep green; leaves roundish or oval, margin entire except in the lower third, border scarcely waved, apex retuse, inner leaves considerably puffed and blistered, veins slightly sunken.

Mature plant about eight inches in diameter, very compact, intense glossy green; forms a small very compact head about two inches in diameter; outer leaves puffed and blistered, and somewhat waved; stem smooth, paniculate, stem leaves numerous, pointing outward, nowhere lanceolate; seeds black.

The plant somewhat resembles in appearance the White Summer lettuce, but is distinguished from it by its deeper green foliage. It is rather late in forming its head, and one of the latest to run to seed.

Figured correctly in Les pl. pot., p. 291.

No. 26. GREEN FAT, *Vil.*, '84.

Synonyms: FR. *Laitue verte grasse.* Vil.,'85; GER. Grüner Feht-salat, Vil.; Vilmorin's grüner feht-salat, s. k. (d.), Dam.

Young plant deep green; leaves short, roundish or spatulate, margin obscurely dentate in the upper half, lower leaves waved and blistered, leaves very thick, veins sunken.

Mature plant about ten inches in diameter, six inches high; head remarkably compact, well defined, three inches in diameter, cream color within, leaves scarcely meeting at the top; outer leaves of plant strongly waved, coarsely blistered, spreading, puffed, blanched towards the base; stem smooth, paniculate, stem leaves rather numerous, half erect; seeds black.

An excellent variety for summer. The head is a little slow in forming, but is very well retained.

Figured correctly in Les pl. pot., p. 297.

No. 27. GREEN FRINGED, *Sib.*, '83.

Synonyms: *California Curled*, Vil.,'84; Paper White Curled,(d.), Thorb.,'84; FR. *Laitue frisée de Californie*, Vil., '85; GER. Californischer Krauser Kopf-Lattich, Vil.

Remarkably distinct. Young plant pale, almost whitish green; leaves decidedly broader than long, erose dentate throughout, very deeply and finely below, border very finely and intricately ruffled, apex retuse, pointing upwards, surface not in the least puffed, but rather sparsely blistered with peculiar wart-like blisters. The outer leaves curve downward showing plainly the upper surface with its peculiar veining; midribs very finely divided into numerous radiating veins.

The mature plant forms a true and beautiful rosette nine inches or more in diameter; leaves not crowded, the outer ones flat upon the ground, the central ones erect; does not form a true head, though in slightly crowded plants, the inner leaves embrace each other loosely; stem smooth, branches few and short, stem leaves numerous, pointing outward, densely ruffled, surface smooth except towards base of stem.

This interesting lettuce must be regarded as more ornamental than useful, as its leaves are neither tender nor sweet.

Figured correctly in Les pl. pot., p. 305.

No. 28. GREEN TENNIS BALL, *Vil.*, '84.

Synonyms: *Boston, Thorb.*, '85; Button, Burr; Capuchin, Burr; *Early Tennis Ball*, Ferry, *Thorb.*, '85 (d.); Green Ball, Burr; Tennisball, Burr; Tennisball, b. s., Vil.; FR. Laitue d' Aubervilliers, Vil.; L. gotte verte hâtive, Vil.; L. *tennisball, Vil.*, '84.

Young plant very deep green, often inclining to wheelform; leaves spreading, roundish or oval, dentate only towards the base, apex retuse, border of inner leaves slightly undulate, and their surface puffed and blistered, veins not very conspicuous.

Mature plant eight to ten inches in diameter, of a peculiar deep, almost glaucous green, compact; outer leaves slightly waved, nearly smooth, inner leaves blistered; head well defined, roundish, solid when grown in cool weather, but loose and open, often none at all if grown in summer; stem smooth, branching low, densely corymbose; seeds black.

Much grown for forcing. It is very hardy to endure cold, takes up little room in frames, is slow in running to seed, blanches well, and is tender.

A very old variety. The name was used by M'Mahon in 1806, and by other American garden writers in 1819, 1821, 1828, 1832, etc. It seems to be the Green Ball of Mawe, 1778, and Anton Pinæus' figure of a lettuce in his Hist. Plantarum, 1561, may be this variety.

No. 29, GREEN WINTER OF NAPLES, *Dam.*, '83.

Young plant very deep green, leaves roundish or oval, dentate only in the lower third, apex retuse, outer leaves usually waved, often slightly spoonform, borders of inner leaves slightly undulate and their surface puffed and blistered, veins not conspicuous.

Mature plant about eight inches in diameter, borders of inner leaves sometimes tinged brown; forms a rather loose open head, of which the outer leaves recurve at the apex, inner leaves densely puffed and blistered, outer ones coarsely but slightly blistered; stem smooth, corymbose; seeds white or grayish.

Of little value unless it be for forcing. Sown early in spring in the open ground, it headed poorly and soon ran to seed.

Figured correctly in Damman & Co's catalogue of 1882-3.

No. 30, HAMMERSMITH, *Vil.*, '84.

Synonyms: Early Dwarf Dutch, Thomp.; Early Frame, Thomp.; Green Cabbage, Thomp.; Green Dutch, Thomp.; Green Winter Cabbage (d.), Burr; *Hammersmith Hardy Green, Bliss*, '83; Hardy Green, Thomp.; *Hardy Green Winter, Thorb.*,'83, *Vil.*, '84; Hardy Hammersmith, Thomp.; Hardy Winter Cabbage, Burr; Prussian Cabbage, Thomp.; Roman Cabbage, Thomp.; FR. Laitue morine, Vil.; GER. Gelber Winter Zarter Lattich, Vil.; Italian, Lattughe verde, Thomp.

Young plant pale, slightly yellowish green, often wheelform; leaves roundish or oval, apex retuse, outer leaves somewhat blistered, inner leaves much puffed and blistered, veins not conspicuous.

Mature plant yellowish green, eight to ten inches in diameter, outline rather irregular; outer leaves oval, waved, puffed; head rather compact, slightly oblong, moderately firm, surrounded by much blistered leaves which are usually a little paler than the outer ones; stem very short, slender, smooth, corymbose; seeds white.

Considered the hardiest of all varieties. The seed is often sown in September, and the young plants protected through the winter with a light covering of straw, to be used in spring as cut lettuce. It is also grown for forcing. In summer the plants attain little size, and usually do not head, soon running to seed.

Figured correctly in Album de clichés.

This variety is mentioned in M'Mahon's Am. Gard. Cal., 1806.

No. 31, HANSON, *Thorb.*, '83, *Sib.*, '85.

Very closely resembles the Early Simpson, but the plant is possibly somewhat larger in growth, and forms a more compact head. An expert is required to distinguish the two varieties. The plant produces little seed; seeds white.

Carter's Giant White, Everitt, '85, seems to be a sub-variety of the above, which in some cases forms a very well defined roundish head; in others, the plants are not distinguishable from those of Hanson.

A variety having the foliage strongly washed with brownish red has in some localities been disseminated as Hanson lettuce.

No. 32, IMPERIAL, Vil., '84.

Synonyms: Asiatic, Vil., Green, w. s., Vil.; Imperial Head (d.), Burr; Imperiale or Grosse Allemande (d.), Thomp.; Union, Vil.; FR. *Laitue impériale*, Vil., '84; L. incomparable, à gr. bl., Vil.; GER. Grosser gelber asiatischer Lattich, w. k., Vil.; Silber-kopfsalat, Vil.

Differs from the Butter lettuce in very little except in the color of its seed, which is white. The two varieties have the same qualities.

Figured correctly in Les pl. pot., p. 297.

The name, Imperial Cabbage, occurs in Mawe's Gardener, 1778; Imperiale or Grosse Allemande in Noisette, 1829; Imperial in M'Mahon's Am. Gard., 1806, and in American writers in 1819, 1828, 1832, etc.

No. 33, IMPROVED SPOTTED, w. s., *Vil.*, '84.

Synonyms: *Improved Spotted Cabbaging, Greg.*, '83; Small dark red, Vil.; FR. *Laitue sanguine améliorée*, Vil., '85; GER. Bunter Forellen Salat, Vil.; Bunter Verbesserter Forellen Kopf-Lattich, Vil.

Young plant very finely spotted with rich brownish red, the inner leaves almost completely covered; more or less wheelform; leaves roundish or oval, apex retuse, surface of inner leaves puffed and blistered.

Mature plant about ten inches in diameter, five inches high, compact; leaves very densely washed or spotted with deep brownish red, on some plant with carmine red; forms a very compact roundish head about three inches in diameter, the inner leaves of which are ivory white, very finely sprinkled or striped with carmine red; outer leaves strongly waved, all puffed and blistered, the blisters not prominent; stem striate, sometimes flattened, much washed with purple, paniculate, stem leaves large, numerous, spotted with purple or chocolate brown to the top, much waved.

"This variety is productive under a small volume; it is early and holds its head well. The very lively color of the spots contrasts agreeably with the whitish leaves, giving the salad a very pretty appearance, while it is of excellent quality." Vil.

Figured correctly in Les pl. pot., p. 301.

No. 34, LARGE NORMANDY, *Vil.*, '85.

Synonyms: *Large Yellow Seeded Normandy, Vil.*, '84; FR. *Laitue grosse Normande, Vil.*, '85.

Young plant deep green, often distinctly wheelform; leaves roundish spatulate or oval, obscurely dentate in the upper half, apex entire or retuse, border very coarsely undulate; outer leaves usually strongly waved, little puffed and blistered, sometimes folded on the midrib.

Mature plant about ten inches in diameter, six inches tall, deep glossy green; head roundish, about three inches in diameter, well defined, pale green, cream color within, outer leaves of head nearly perpendicular, often curving in and then outward at the apex; outer leaves of plant strongly waved, much puffed and blistered; stem smooth, branching low, head corymbose; seeds yellow.

Resembles the Green Fat Lettuce, but the leaves are more blistered, and the veins are not sunken.

Well adapted to summer culture.

No. 35, LARGE WHITE STONE SUMMER, *Sib.*, '83, *Vil.*, '84.

Synonyms: *Large Green, Vil.*, '84; Nonpareil, Vil.; Very Large Yellow Paresseuse, Dam., '83; *White Cabbage, Batch.*, '82, Thorb., '83; FR. *Laitue grosse blonde Paresseuse, Vil.*, '85; L. blonde d'été de St. Omer, Vil.; L. nonpareille, Vil.; GER. Gelber Faulenzer Lattich, Vil.; Grosser gelber Dauer-kopf-L., Vil.

Young plant pale yellowish green; leaves roundish or oval, obscurely dentate in the upper half, apex usually entire, inner leaves puffed and blistered, with undulate borders. Before heading the plant is conspicuous for its broadly spreading vigorous foliage, and for its densely blistered inner leaves, which in some plants extend almost horizontally.

Mature plant twelve to fifteen inches in diameter, comparatively low and spreading, the very ample outer leaves laying upon the ground; forms a very large though not very compact, yellowish, roundish head, which sometimes attains a diameter of six inches; the head surrounded by very large, nearly perpendicular blistered leaves, which incline to inclose it loosely; leaves closely blistered throughout; stem smooth, paniculate; stem leaves numerous pointing outward, the uppermost ones approaching spatulate, smooth, ears small, rounded; seeds white.

One of the best of all the summer lettuces. It endures the heat and holds its head remarkably well, and very rarely fails to produce a good crop. Owing to its very large size, and rapid development it becomes fit for use nearly or quite as early as the spring lettuces.

Figured correctly in Les pl. pot., p. 296.

No. 36, LARGE WHITE WINTER, *Vil.*, '84.

Synonyms: FR. *Laitue grosse blonde d'hiver, Vil.*, '85; GER. Grosser fester gold-gelber Kopf-Lattich, Vil.

Young plant pale, slightly yellowish green; leaves oval, approaching spatulate, coarsely erose dentate in the lower half, obscurely dentate above, apex retuse, borders of inner leaves somewhat ruffled, of the outer ones undulate, inner leaves very finely puffed and blistered. Resembles Neapolitan lettuce, but is less deep green, less blistered, and less ruffled.

Mature plant about twelve inches in diameter, rather tall, outline very irregular; outer leaves coarsely undulate, or ruffled, half erect; head roundish, large, pale yellowish green, composed of, and surrounded by extremely blistered, waved and twisted leaves; stem smooth, corymbose; seeds white.

Of no special value as a summer lettuce.

Figured correctly in Les pl. pot., p. 288.

No. 37, LE BŒUF, *Vil.*, '84.

Synonyms: Intermediate Lebœuf, Vil.; FR. *Laitue Lebœuf*, Vil., '84; GER. Grosser grüner Lebœuf Lattich, Vil.

Young plant clear green; leaves oval, approaching spatulate, nearly half erect, apex entire or retuse, borders of inner leaves somewhat undulate, surface finely blistered, often puffed, veins slightly sunken, not conspicuous, midribs slightly prickly below.

Mature plant about nine inches in diameter and of equal height; rather intermediate between the Cos and Cabbage lettuces; leaves oblong, oval, outer ones strongly waved, puffed, but very little blistered; inner leaves finely puffed and blistered; head tall, resembling that of a Cos lettuce, composed of leaves pressed against one another, but inclosing one another imperfectly. In some plants the leaves do not form a head, but all curve outward from the center; stem stout, smooth, corymbose, stem leaves half erect; seeds white.

This lettuce bears some resemblance to the Ground Cos. "It possesses the peculiarity of often throwing out suckers at the base of the head." Vil.

Figured correctly in Album de clichés.

No. 38, LORTHOIS, *Vil.*, '85.

Synonyms: FR. *Laitue de Trocadéro*, Vil., '84; L. maraîchère, Vil.

Young plant pale green; leaves roundish or oval, margin more or less dentate and slightly ruffled in its whole outline, outer leaves slightly waved; surface nearly smooth except in the innermost leaves in which it is slightly puffed and blistered; midribs greenish white, veins slightly sunken.

Mature plant ten to twelve inches in diameter, five inches tall; forming a very compact, globular head four inches in diameter, of which the outer leaves are bordered with brown, and scarcely fold back at the apex, inner leaves of head well blanched; outer leaves of plant little blistered, borders ruffled; stem smooth, corymbose; seeds white.

A good lettuce for either spring or summer.

No. 39, MADERIA, *Vil.*, '85.

Synonyms: *Large Winter, w. s., Vil.*, '84; Large Winter Cabbage (d.), Burr; Large Winter Maderia, Vil.; FR. Laitue Babiane, Vil.; L. brune d'hiver des Carmes, Vil.; *L. de la Passion, Vil.*, '85; *L. passion, Vil.*, '85; L. Passion d'hiver, Vil.; GER. Grosser grüner Winter Kopf-Lattich, Vil.

Young plant often inclining to wheelform, clear green; inner leaves sometimes slightly yellowish, sparsely spotted with chocolate brown, apex entire or retuse, outer leaves slightly waved, inner ones puffed and blistered.

Mature plant about ten inches in diameter, spreading, with a somewhat irregular outline; head roundish, rather large, pale green, washed with red on the summit; outer leaves little blistered, waved, with undulate borders, clear green, slightly yellowish, with a few brown spots; leaves about the head blistered and tinged with red on the borders; stem smooth, broadly corymbose; seeds white.

Resembles the Mogul lettuce; but the margins of the leaves are not dentate in the upper half, and the leaves are more oval.

This variety is not adapted to summer culture, as unless sown very early in spring, it heads poorly, and runs quickly to seed.

Figured correctly in Les pl. pot., p. 287.

It was mentioned in L'Hort. Francais, 1824, by Pettit in 1826, by Noisette in 1829, etc.

No. 40, MALTA, *Vil.*, '84.

Synonyms: Drumhead, Vil. (d.), Burr; Ice Cabbage, Ben.; Ice Cos, Burr; *Ice Drumhead*, Vil., *Batch.*, '82; Malta Drumhead, Vil., '84; Malta Large Drumhead, Sib., '83; *Satisfaction, w. s., Sib.*, '85; White Cabbage, Burr; *White Nonpareil, Carter*, '84; White Silesian, Browne; FR. Laitue chou blonde, Vil.; *Laitue de Malte*, Vil., '84;

Ger. Grosser gelber Trommel-kopf-Lattich, Vil.; Grosser Trommel-kopf-L., Vil.

Young plant pale yellowish green; leaves roundish or oval, sometimes spatulate, dentate throughout, apex entire, borders finely ruffled, surface of outer leaves nearly smooth, of inner ones finely blistered, veins sunken, rather conspicuous.

Mature plant twelve to fourteen inches in diameter, and of nearly equal height, rather compact, pale green, glossy; forms a distinct and rather compact head, of which the outer leaves are hoodshaped, curving backward at the borders, densely blistered; outer leaves of the plant rather sparsely blistered, scarcely puffed; stem smooth, corymbose, stem leaves numerous, smooth, ears prominent; seeds white.

This variety grows rapidly, stands the heat well, but is late in forming the head, and the latter is not long retained. It is of excellent quality.

Figured correctly in Les pl. pot., p. 304.

Mentioned by Vilmorin in 1823, and in L'Hort. Fran., 1824.

No. 41, MOGUL, *Vil.*, '85.

Synonyms: Large Brown Cabbage (d.), Burr; Large Brown Coblenz, b. s. (d.), Dam.; Large Gray Cabbage, Burr; *Large Green, b. s., Vil.*, '85; Mammoth, Burr; Superfine New French, Thomp.; Fr. Laitue Bapaume, Vil.; L. Berg-op-Zoom, Vil.; L. de Hollande, Thomp.; L. grise maraîchére, Vil.; *L. grosse brune Paresseuse*, Vil., '85; L. grosse grise, Vil.; L. grosse hollandaise, Vil.; L. Méterelle (à Bordeaux), Vil.; L. prodigieuse, Vil.; Ger. Brauner Faulenzer-Lattich, Vil.; Brauner Koblenzer, s. k. (d.), Dam.

Young plant low and spreading, sometimes inclined to wheelform, dull, somewhat grayish green, with a few scattering chocolate colored dots; leaves roundish spatulate, or ovate spatulate, obscurely dentate in the upper half, apex retuse, outer leaves often slightly waved, little puffed or blistered, inner leaves much waved, densely puffed and blistered, veins slightly sunken.

Mature plant about twelve inches in diameter, six inches high, very sparsely spotted with chocolate brown; outer leaves numerous, spreading, coarsely puffed and blistered; forms a compact, roundish, not very well defined head, about four inches in diameter, cream colored within, sometimes tinted with brown on the top. The outer leaves of the head do not meet at the top; leaves surrounding it nearly perpendicular, curving outward at the apex; stem smooth, paniculate; seeds black.

A Very hardy and productive variety, well adapted for summer culture.

Figured correctly in Les pl. pot., p. 296.

No. 42. MORTATELLA, *Vil.*,'84.

Synonyms. Mortatella Cabbage, Vil.; Fr. *Laitue Mortatella, Vil.*, '84.

Young plant intense clear green, slightly wheelform; leaves oval, apex entire or retuse, outer leaves waved, or sometimes spoonform, surface nearly smooth, inner leaves puffed and blistered.

Mature plant about nine inches in diameter, forming a rather compact head two to three inches in diameter, yellowish green within, outer leaves of head washed with dark brown where exposed to light, much blistered, curving outward at the apex; outer leaves of plant coarsely blistered ; stem smooth, densely corymbose ; seeds black.

The head is slow in forming, and is not long retained.

Figured correctly in Album de clichés.

No. 43. Neapolitan, *Vil.*, '84.

Synonyms. Naples Cabbage, (d.), Burr; *Neapolitan Cabbage, Vil.*, '84, *Sib.*, '83; *New Giant of Salermo, Dam.*,'84; Fr. *Laitue chou de Naples, Vil.*,'85; Ger. Grosser gelber Kopfsalet von Neapul, w. k., (d.), Dam.; Neapolitanischer Dauerkopf-Lattich, Vil.

Young plant intense clear green, rather spreading; leaves roundish or oval, borders finely ruffled, surface of outer leaves smooth, of inner ones finely blistered, veins sunken conspicuous.

Mature plant twelve to fourteen inches in diameter; the larger leaves often six inches wide, glossy, strongly waved, sometimes spoonform, irregularly blistered; outer ones nearly flat upon the earth; head large, rather clearly defined, often flattened on the top, three to four inches in diameter, outer leaves of the head hoodshaped, completely overlapping one another, clear glossy green, the finely ruffled border curving back a little, inner leaves whitish green, often becoming bitter before the flower stalk starts ; stem striate, little branched, paniculate, producing little seed; seeds black.

"This variety is perhaps of all the lettuces the one that holds its head best. The floral stem is often unable to break through the leaves without aid." (Vil.) "Aside from the tardiness of the plant in flowering, the yield of seed is never abundant." (Burr).

In the Station garden this variety has not always headed well, and has not retained its head longer than several others.

Figured correctly in Les pl. pot., p. 303.

The Large Saint Angelo, *Dam.*, '83, was slightly smaller in size than the Neapolitan, but scarcely different in other respects. We think it not sufficiently distinct to be described as a separate variety.

No. 44. Negrohead, *Ben.*, '83.

Synonym. Milan, *Ben.*, '83.

Young plant dull green, much washed with dark reddish brown where most exposed to light; leaves oval, apex entire or retuse, outer ones waved, inner ones somewhat folded on the midrib, puffed and blistered, veins not very conspicuous.

Mature plant about twelve inches in diameter, the inner leaves much washed with dark reddish brown on the borders; forms a pretty well defined, compact, roundish or slightly oblong head about three inches in diameter, greenish yellow within ; outer leaves of plant much waved, little blistered, inner leaves much puffed and blistered; stem smooth, washed with purple, corymbose, stem leaves pointing outward, leaves on the branches bordered with rich purple; seeds yellow.

Endures the heat well, and is slow in running to seed; but not sure to head unless sown very early.

No. 45. PALATINE, *Vil.*, '84.

Synonyms. Brown Cabbage, (d.), Burr; *Brown Genoa, Vil.*, '84; *Grise, Dam.*, '84; Fr. Laitue brune d'Achicourt, Vil.; L. brune d'Arras, Vil.; L. brune hollandaise, Vil.; L. incomparable, Vil.; L. jeune brune, Vil.; L. oeil-de-perdrix, Vil.; L. *palatine, Vil.*, '85; L. petite brune, Vil.; L. roulette d'été à, gr. n., Vil.; L. rousse, Vil.; L. Palatine rousse, Noisette; Ger. Brauner fester Pariser Lattich, Vil.

Young plant green, much washed or spotted with brown with a few scattering chocolate colored dots; leaves broadly ovate spatulate, or roundish, obscurely dentate in the upper half, apex retuse, borders of inner leaves somewhat undulate, and their surface puffed and blistered, midribs whitish green above, usually tinged with purple below, veins rather conspicuous.

Mature plant, spreading, about ten inches in diameter; outer leaves tipped with a peculiar reddish copper color, all leaves sparsely spotted with chocolate brown; forms a rather loose and poorly defined head about three inches in diameter, of which the inner leaves are yellowish green, finely puffed and slightly blistered; outer leaves waved; stem smooth, purple, paniculate, stem leaves pointing outward, tinged with purple, sparsely spotted with chocolate color, paniculate; seeds black.

"No lettuce is superior to this for summer and autumn. It forms promptly, holds its head well, and endures the cold well. During the latter part of Summer and the entire Autumn this variety furnishes more than half of the head lettuce that is carried to the Paris market." Vil.

"Must be classed as one of the best." Burr.

Figured correctly in Les. pl. pot., p. 300.

No. 46. PELLETIER, *Dam.*, '83, *Vil.*, '85.

Synonyms. *Curled Beauregard, Vil.*, '85; Laciniated Beauregard, (d.), Vil.; Fr. Laitue Beauregard, Vil.; L. Beauregard à feuille laciniée, Vil.; *L. frisée à couper Beauregard,* Vil., '85; Ger. Geschlitzter Beauregard Kopf-Lattich, Vil.

Very distinct; young plant pale yellowish green, leaves deeply cut, the edges of the pointed lobes folding together below, causing the apexes to point upward; midribs broad at the base, dividing into very numerous translucent veins.

Mature plant about eight inches in diameter; forms a compact, well defined, pointed head three inches in diameter; leaves neither puffed nor blistered; stem tall, smooth, paniculate, stem leaves deeply dentate to the top, ears long, narrow, sharply pointed; yields very little seed, many plants forming no flower stalk; seeds black.

Quite ornamental, but of little value for the table, owing to its small size, lateness and inferior quality.

Figured correctly in Les pl. eot., p. 305.

No. 47. PRIZE HEAD, *Sib.*, '83.

Synonyms. *American Curled, Vil.*, '84; *American Gathering*, Vil., *Sib.*, '83, *Thorb.*, '85; American Gathering Head, (d.), Breck; *Ferry's Early Prize Head*, Ferry, '83; India Head, Vil.; New American, Vil.; Fr. Laitue d'Australie, Vil.; L. blonde dorée, Vil.; L. dorée d'Amerique, Vil.; L. frisée d'Amerique, Vil.; L. pommée du

Texas, Vil.; Romaine rouge, dorée, Vil.; Ger. Krauser Amerikanischer Pflück-Lattich, Vil.

Leaves of the young plant more or less washed and speckled with brownish red on both sides, oval or roundish, border distinctly ruffled, apex pointing upwards, inner leaves most colored, much blistered.

Mature plant about twelve inches in diameter, central leaves dark rich red where most exposed; head not clearly defined, the densely ruffled and blistered inner leaves being compactly folded together in apparent confusion; stem smooth, slightly washed with purple, paniculate, stem leaves numerous, pointing outwards, inclining to ruffle, borders strongly tinged with purple, ears half embracing, pointed, very prominent; seeds white.

An excellent variety, early, slow in running to seed, and very tender and well flavored. "Derived from the Batavia lettuce." Vil.

No. 48. RED BESSON, *Greg.*, '83, *Sib.*, '83, *Vil.*, '84.

Synonyms. *Marvel, Vil.*, '84, *Sib.*, '83; Fr. Laitue Besson, Vil.; *L. merveille des quatre saisons, Vil.*, '85; L. mousseline rouge, Vil.; Ger. Rothbrauner Besson oder Wunder Kopf-Lattich, Vil.; Winter Kopf-Lattich, Vil.

Young plant dull dark red; the inner leaves glossy, leaves roundish or oval, apex retuse, inner leaves slightly blistered, veins brownish above, midrib reddish above, slightly more greenish below.

Mature plant about twelve inches in diameter, rich glossy red in all parts exposed to the light; head well defined, roundish, about four inches in diameter, the outer leaves of it exposing their lower surfaces, inner leaves nearly white; leaves about the head, and outer leaves of plant densely puffed and blistered; stem short, slender, smooth; seeds black.

An excellent lettuce for spring or summer. It endures the heat well, and is very slow in running to seed.

Figured correctly in Les. pl. pot., p. 300.

No. 49. RED EDGED VICTORIA, Vil.

Synonyms. *Boston Market, Hend.*,'84; Early Cabbage, Vil.; Early Paris Market, Vil.; Early Yellow, Vil.; Red Bordered, Vil., Burr; *Red Edged, Vil.*, '84; *Victoria, Vil.*, '84; *Ward's Improved White Tennis Ball, Greg.*, '85; White Dutch, Vil.; Fr. *Laitue à bord rouge, Vil.*,'85; L. Bordelande, Vil.; L. Cordon rouge, Vil.; Ger. *Bruine Geel Lattich, Vil.*,, '85; Gelber rothkantiger Prinzenkopf L., Vil.; Holl. Broei gele latouw, Vil.; Harlems' che gele L., Vil.

Young plant pale, slightly yellowish green, more or less wheelform in its early stages of growth; leaves roundish or oval, apex retuse, borders coarsely undulate, surface waved, puffed in the lower half, scarcely blistered.

Mature plant seven to ten inches in diameter, about five inches high, compact; outer leaves roundish, almost plain, lying on the earth, those that surround the head very pale yellowish green, often tinted with brown on the borders, which point outwards, the brown disappearing at a later stage of growth, coarsely blistered, puffed towards the base; head very solid, clearly defined, about three and a half inches in diameter, four inches tall, the leaves composing it very pale yellow; the outer leaves of the head do not quite meet at the top ; stem short, faintly washed with brown, compactly corymbose ; seeds white.

Figured correctly in Les pl. pot., p. 293.

The names Red Bordered, Red Edged Victoria, etc., under which this variety has long been known, seem objectionable because as grown by us, the borders are not red at any stage of growth, and the name Victoria has been applied to at least three other varieties.

A " White Dutch" lettuce was mentioned by M'Mahon in 1806, and in the Gardeners' Chronicle in 1850; a "Laitue a bord rouge," in L'Hort. Franc., 1824, and in other writers 1826, 1829, etc. Red Edged Victoria is described in Gardener's Chronicle, 1868; Victoria or Red Bordered by Burr in 1863, etc.

No. 50. RED WINTER CABBAGE, *Thorb.*, '84.

Synonyms. *Hardy Red Winter, Vil.*, '84; Fr. *Laitue rouge d'hiver, Vil.*,'85; Ger. Rother fester winter Kopf-Lattich, Vil.

Young plant low and spreading, often inclining to wheelform, clear green, more or less washed with reddish brown, especially in the inner leaves, which are often spoonform, with undulate borders; leaves roundish or oval, apex retuse, outer leaves somewhat waved, nearly smooth, inner ones puffed and blistered.

Mature plant about ten inches in diameter, open and spreading ; leaves where most exposed to light, tinged with reddish brown; head large, slightly oblong, compact, forming promptly and enduring rather a long time, pale green, very strongly tinted with reddish brown ; leaves around the head coarsely puffed and blistered ; stem slender, smooth, mostly red, corymbose ; seeds white.

Heads well only when grown in cool weather. Unless sown very early in spring it is of little value.

Figured correctly in Les pl. pot., p. 289.

No. 51. ROQUETTE, *Vil.*, '84.

Young plant intense deep green; leaves roundish, dentate and undulate in their whole outline, apex retuse, pointing upwards, all leaves more or less blistered, inner ones densely blistered and puffed, midribs and veins greenish white, the latter conspicuous, slightly sunken.

Mature plant four to six inches in diameter; forms a remarkably solid little head about two inches in diameter and three inches long; leaves densely blistered, very mild but a little tough; seeds white.

This very distinct lettuce is remarkable for the neatness and solidity of its head, which is almost as hard as that of a Winnigstadt cabbage. Its small size would seem to make it desirable for frame culture, but it is very late, which makes it undesirable for this purpose.

No. 52. SHOTWELL'S BROWN HEAD, *Thorb.*, '85.

The outer leaves of the young plant are dull pale green, much washed with brownish red ; inner leaves almost completely red ; plant low and spreading; leaves oval or obovate, apex retuse, obscurely dentate in the upper half, inner leaves often spoonform, much blistered and puffed, midribs greenish white.

Mature plant about twelve inches in diameter; forms a rather compact head about four inches in diameter, of which the outer leaves scarcely meet at the top, and are deep brownish red at the apex, inner leaves of the head greenish yellow, faintly tinged or spotted with red; stem smooth, purplish red, speckled with darker spots, paniculate, stem leaves deep rich purple; seeds black.

A good variety for summer. It is slow in forming the head, but very slow in running to seed.

This variety closely resembles the Improved Spotted (w. s.), the chief difference in their appearance being that the head of this is little stained with red within, and the outer leaves are a little darker brown. It forms very little seed, few plants being able to burst the head.

No. 53. STONE HEAD GOLDEN YELLOW, *Greg.*, '84.

Young plant pale yellowish green, often approaching wheelform; leaves roundish, scarcely dentate, even towards the base, outer ones strongly waved, surface nearly smooth, inner leaves puffed and blistered, with undulate margins.

Mature plant about ten inches in diameter, conspicuous for its pale yellow color; forms a compact, oblong head three inches in diameter, of which the outer leaves curve outward at the apex, leaves surrounding the head quite spreading, much puffed and blistered.

This variety is rather early, heads well and is of excellent quality.

No. 54. SUGAR LOAF, *Greg.*, '83.

Synonym. *Victoria Cabbage, Thorb.*, '84.

Young plant very vigorous, dull green, more or less washed with brownish red, the inner leaves often completely colored; leaves oval or shortly spatulate, dentate in their whole outline, obscurely towards the apex which is retuse, borders ruffled in such a way that the apexes of the folds always point upward, inner leaves somewhat blistered, veins usually brownish.

Mature plant about twelve inches in diameter, nine to twelve inches high; leaves washed with brown where most exposed to light, curving downward, coarsely puffed and blistered, borders slightly ruffled; forms a large, loose, oblong, not well defined head, of which the outer leaves are hood-shaped, rolling back a little on the borders; stems very tall, smooth, washed with purple, corymbose, stem leaves half erect, very broad at the base, very numerous; seeds white.

The head is not long retained, and is very slow in forming. An excellent summer lettuce, giving a most productive crop of excellent quality.

Introduced by Gregory about 1880.

No. 55. TENNIS BALL, w. s., *Vil.*,'84.

Synonyms. Boston Market, w. s., Vil.; *White Forcing Head, Thorb.*,'83; White Gotte, w. s., (d.), Burr; White Seeded Gotte, (d.), Thomp.; *White Seeded Tennis Ball*, Sib.,'83; *White Tennisball, w. s., Vil.*, '84; Fr. Laitue d'Ognon, Vil.; L. gau, Vil.; *L. gotte à gr. bl.*, Vil.,'85; Ger. Sehr früher fester Steinkopf Lattich, Vil.; Sehr früher gelber fester Steinkopf L., w. k., Vil.

Young plant pale yellowish green, very compact; leaves roundish, apex retuse, outer ones somewhat waved, nearly smooth, inner ones coarsely undulate, much blistered, midribs concealed in the compact foliage.

Mature plant about six inches in diameter, very compact; forming a firm head one and a half to two inches in diameter, three inches tall, of which the outer leaves curve back at the apex; leaves forming and surrounding the head puffed and blistered; head lighter in color than the outer leaves; stem short, smooth, broadly corymbed; seeds white.

Very largely grown for earliest culture under frames. Of little value for out door culture unless sown very early.

The Early Egg Cabbage, *Vick*, '85, seems to be an improved selection of this variety, somewhat larger in size, and running to seed less promptly.

Figured correctly in Les pl. pot., p. 291.

Mentioned by Petit in 1826.

No. 56. THE DEACON, *Harris*, '83.

Young plant clear deep green, rather low and spreading; leaves roundish or shortly spatulate, margin obscurely dentate in the upper half, apex entire, inner leaves somewhat puffed and blistered, veins sunken, conspicuous, leaves very thick.

Mature plant very compact, about twelve inches in diameter, remarkable for its finely formed, large, firm head, which often attains a diameter of five inches. When first formed the head is oblong, but later it becomes roundish, and finally distinctly flattened on the top. The outer leaves are very few and in the fully matured plant lie flat upon the ground so that there seems to be little of the plant except the head; stem smooth, greenish white, corymbose, stem leaves pointing outward, obovate, very broad at the base, waved and blistered; with very small rounded or bluntly pointed ears; leaves on the branches oblong, pointed, with nearly parallel sides; seeds white.

As the plant matures the foliage assumes a lighter shade, and the leaves become yellowish on the borders; the head within is cream colored, and continues sweet and tender until the flower stalk starts.

This variety was introduced about the year 1879 by Mr. Joseph Harris, of Moreton Farm, Rochester, N. Y., who procured the seed from a Mrs. Müller, a German lady who had selected the variety carefully for many years.

No. 57. TOM THUMB, *Vil.*, '84.

Synonyms. *Stone Tennis Ball, Vil.*, '84, (d.), Burr; *Wheeler's Tom Thumb. Thorb.* '83; Fr. *Laitue gotte lente à monter, Vil.* '85; Ger. Früher grüner fester Steinkopfh-Lattich, Vil.; Grüner fester Steinkopf L., Vil.

Young plant spreading, inclining to wheelform, very pale green; leaves oval, rarely roundish, apex distinctly retuse, surface of outer leaves slightly and of inner ones very much blistered, sometimes puffed, veins not conspicuous.

Before forming the head the plant is distinct through its very densely blistered, spreading upper leaves and white midribs.

Mature plant about ten inches in diameter and six inches high, pale yellowish green, remarkably compact; forming an extremely firm, roundish head, nearly or quite four inches in diameter, but which owing to the compact foliage is not clearly defined; the outer leaves of the head curve back at the apex; lower leaves of plant horizontal, all much puffed and blistered; stem rather tall, smooth, corymbose, stem leaves numerous, pointing outward; seeds black.

Not very large in size, but excellent in quality. It is early and holds its head remarkably well.

Introduced by H. Wheeler & Son, Eng., in 1858. (Gar. Chron.)

Figured correctly in Les pl. pot., p. 292.

The synonym Gotte lente à monter was grown by Thompson in 1850.

No. 58. TROUT, *Farq.*, '85.

Synonyms. Fr. Laitue flagella, Vil.; L. panachée, Vil.; L. sanguine à gr. bl., (d.), Vil.; L. truite, Vil.

Young plant pale green, densely spotted with small chocolate brown spots, spreading, often inclining to wheelform; leaves roundish or oval, apex entire or retuse, outer leaves strongly waved, usually more or less puffed, inner ones much puffed and blistered.

Mature plant about ten inches in diameter, five inches high, compact, dull green, densely and finely spotted with reddish brown; forms a rather well defined, compact, roundish head about three inches in diameter, of which the inner leaves are speckled on a nearly white ground; outer leaves much waved, coarsely puffed and blistered; stem smooth, purple, corymbose, stem leaves roundish, pointing outward; seeds white.

A good summer lettuce, heading well, and very slow in running to seed.

No. 59. VERSAILLES, *Vil.*, '84.

Synonyms. Large Mogul, w.s., (d.), Dam.; *Large Versailles, Vil.,* '85; *Large White Versailles, Vil.,*'85; *Large Yellow Cyrius, Dam.,* '83; Non Plus Ultra, w.s., (d.), Dam; *Versailles Cabbage, Greg.,*'83; Fr. Laitue blonde royale, gr. bl., (d.), Dam.; L. de Versailles, (d.), Noisette; *L. blonde de Versailles, Vil.,*'85; Ger. Cyrius Lattich, Vil.; Gelber Cyrius, Vil.; Grosser gelber Cyrius, L., Vil.; Grosser gelber non plus ultra, L., w.s., (d.), Dam.; Grosser gelber Savoyer L., Vil.; Mogul L., Vil.

Young plant clear green; leaves roundish or oval, apex retuse, surface of inner leaves puffed and blistered, midribs whitish, veins rather conspicuous.

Mature plant about twelve inches in diameter, very compact; forms a compact head three inches in diameter, of which the densely blistered leaves seem crowded together in untraceable disorder; leaves surrounding the head blistered and puffed in a remarkableemanner, lower leaves coarsely puffed and blistered, with coarsely undulate borders; stem paniculate, stem leaves nearly smooth, usually pointing downwards; seeds white.

"This variety forms its head quickly and uniformly, cabbages white and crisp, is slow in shooting up to seed, and flourishes in almost every description of soil." Burr. It is tender and of good flavor, though the leaves sometimes become bitter before the flower stalk forms.

Figured correctly in Album de clichés.

Described by Browne in 1854, by Thompson in 1850, and in L'Hort. Franc. in 1824.

No. 60. VERY EARLY DWARF GREEN, *Vil.*, '84.

Synonyms: *Dwarf Green Early, b.s., Greg.*, '84; *Earliest Dwarf Green, Vil.*, '84; *Landreth's Forcing, Land.*, '85; FR. *Laitue nain vert très hâtive, Vil.*, '84.

Young plant very deep green, extremely compact in growth; leaves broader than long, dentate only in the lower part, apex retuse, borders of inner leaves undulate, surface much blistered, midribs almost concealed in the compact foliage, veins rather conspicuous.

Mature plant about six inches in diameter, very compact, forming a firm head three inches in diameter, the outer leaves of which curve outward at the apex; all leaves blistered, inner ones finely; leaves about the head coarsely undulate, approaching ruffled; stem rather short, branching very low, corymbose; seeds black.

A very early and excellent heading lettuce, superior for forcing.

No. 61. WHITE BATAVIAN, *w. s., Vil.*, '84, *Sib.*, '85.

Synonyms: Drumhead Cabbage, (d.), Burr; Early Silesia, Chis. Trial.; Hooper's Incomparable, Chis. trial.; Large Drumhead, Burr; Large Green Head or Cabbage, (d.), Thomp.; Prince Albert, Chis. trial.; Red Edged Drumhead, (d.), Chis. trial.; *Silesian, Vil.*, '84 Spanish Burr; White Silesian, Vil.; FR. Laitue Batavia à bord rouge, Vil.; *L. Batavia blonde, Vil.*, '85; L. de Silésie, Vil.; L. tête de mort, Vil.; GER. Grosser gelber Kopfmontrée Lattich, Vil.; Grosser gelber montrée L., Vil.; Spater gelber montrée L. (d.), Dam.; HOLL. Groote gele montrée latouw, Vil.

Young plant light, sometimes golden green; leaves open, few in number, roundish or oval; borders ruffled, of inner leaves faintly tinged with brown, surface of outer leaves nearly smooth, of inner ones densely and finely blistered, veins sunken, conspicuous.

Mature plant twelve to fourteen inches in diameter, eight inches high; foliage densely and finely blistered, but not puffed; head slightly oblong, very large, well defined and very solid at its best, very pale green, tinted with light brown or russet, leaves of the head hoodshaped, nearly enclosing one another; those about the head curve outward towards the apex until the head is completely formed, and are usually strongly tinted with brown on the borders, though sometimes almost clear green; stem irregularly striate, often flattened, washed with purple below, branches faintly tinged with purple, sometimes sparsely spotted with deep purple, paniculate, stem leaves numerous, usually pointing downward with very large ears; seeds white.

"Adapted to all seasons, hardy, retains its head well, withstands heat and drought, blanches white and crisp, and is of excellent flavor." Burr.

Figured correctly in Les pl. pot., p. 302.

No. 62. WHITE BOULOGNE, *Vil.*, '84.

Synonym: FR. *Laitue blonde de Boulogne, Vil.*, '85.

Young plant low and spreading, often wheelform, pale yellowish green, with a few chocolate colored spots; inner leaves faintly washed with brown, often spoonform; leaves roundish or oval, apex entire or retuse, borders of inner leaves coarsely undulate, surface puffed and blistered, veins rather conspicuous.

Mature plant about eight inches in diameter; leaves much waved, rather spreading, with little or no tendency to head, when grown in the open ground; innermost leaves golden yellow, puffed and blistered; stem short, broadly corymbose.

This variety very early runs to seed, and is of no value in this climate, unless it be for forcing.

No. 63. WHITE CHAVIGNE,* *Vil.*, '84, *Sib.*, '83.

Synonyms: FR. *Laitue blonde de Chavigné*, Vil.,'85; GER. Gelber von Chavigné Kopf-Lattich, Vil.

Young plant clear green, compact, spreading, often somewhat wheelform; leaves roundish or oval, obscurely dentate in the upper half, apex retuse, margin scarcely undulate, even in the inner leaves of which the surface is slightly blistered, veins sunken, rather conspicuous.

Mature plant about twelve inches in diameter; head clearly defined, large, often five inches in diameter, compact, pale green, almost yellow above, whitish within, the leaves not meeting at the top; outer leaves roundish, coarsely blistered; stem short, slightly striate, paniculate, branches few and short; yields little seed; seeds white.

One of the finest heading varieties we have tested.

Figured correctly in Les. pl. pot., p. 296.

No. 64. WHITE PARON, *Vil.*, '85.

Synonyms: *New Silver Ball, Till.*, '85; *Silver Ball New Winter*, Dam., '84; White Paron Cabbage, Vil.; FR. *Laitue blonde de Paron Vil.*,'85; Silverball d'hiver gris argenter w. s. (d.), Dam; GER. Gelber von Paron Lattich, Vil.; Silverball, neuer Winter w. k. (d.), Dam.

Young plant clear green, spreading; leaves roundish or oval, apex retuse, outer leaves waved, usually more or less puffed, inner leaves often somewhat folded upon the midrib, with more or less undulate borders, much puffed and blistered; veins sunken, conspicuous.

Mature plant about twelve inches in diameter and five inches tall, compact, rather spreading, clear green, with a slight lustre; head not very well defined, three or four inches in diameter, of about equal height, yellowish green within, compact, outer leaves of the head more or less contorted; leaves surrounding the head curving outward at the top; outer leaves coarsely waved, rather sparsely blistered, distinctly puffed, midribs concealed in the compact foliage; stem intermediate between a panicle and corymb, stem leaves half erect; seeds white.

Excellent in quality but rather slow in forming the head, and rather prompt in forming the flower stalk.

Resembles the Turkish or Butter L. but differs from it in having more entire margins, less blistered leaves and a clearer green color, with more lustre.

No. 65. WHITE SUMMER, *Vil.*, '84.

Synonyms: *All the Year Round, w. s., Vil.*, '84; Butter, Vil.; *Everitt's Mammoth Market, Everitt*, '85; Fine Large Mogul, Thomp.; Francfurt Head, Vil.; Frankfort Head, Vil.; Large White Cabbage, Vil.; Late White Cabbage, (d.), Thomp.; Large Yellow Prince's Head, (d.), Dam.; Perpignan Chris. trial.; Prince's Head, Chis.

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*Sometimes written White Charigny.

trial.; Princess, Vil.; *Royal, w. s., Vil.*, '85; Saxony, Thomp.; Swedish, Vil.; Sugar, Thomp.; White Summer Cabbage, Vil.; Fr. Laitue blonde, Vil.; *L. blonde d' été, Vil.*, '85; L. Gapillard, Vil.; L. jaune d'été, Vil.; L. jaune de Harlem, Vil.; L. nonpareille, Vil.; L. pommée de Zéalande, Vil.; L. pommée paresseuse, Vil.; L. Royale à gr. bl., Vil.; Ger. Grosser gelber Prinzenkopf Lattich, Vil.; Haarlemer Blankopf L. Vil.; Haarlemer grosser gelber L. Vil.; Grosser gelber Haarlemer Blankkopf L. w. k., (d.), Dam.

Differs little from the Berlin lettuce, except in the color of its seed. Young plant pale green, sometimes inclining to yellowish; leaves roundish or oval, sometimes obovate, apex retuse, surface much puffed, especially in the inner leaves, scarcely blistered.

Mature plant compact, nine to twelve inches in diameter; forms a very compact, and clearly defined, roundish head about three inches in diameter, of which the leaves are very pale, almost whitish green; leaves about the head slightly spreading, strongly waved, the visible surface almost completely covered with rather large regular roundish blisters; stem smooth, head paniculate; seeds white.

One of the varieties most generally diffused. It is rather early, heads well in warm dry weather, is slow in running to seed, and of excellent quality. We regard it as one of the best for out door cultivation.

Figured correctly in Les. pl. pot., p. 295.

Cos Lettuces.

No. 66. Ballon Cos, *Vil.*,'84.

Synonyms: *Romaine Ballon, Vil.*, '84; R. de Bougival, Vil.

Young plant rather pale green, leaves broadly obovate spatulate, margin erose dentate, border scarcely undulate, apex entire or pointed, surface of inner leaves slightly puffed and blistered.

Mature plant about fifteen inches in diameter and twelve inches high; head large, thick, roundish, slightly flattened on the top. The plant forms only a loose oblong head without tying; inner leaves finely blistered, but not puffed, outer leaves more coarsely blistered, slightly folded on the midrib, border scarcely undulate; stem irregularly striate, often flattened, stem leaves numerous, nearly erect, inversely spoonform; seeds black.

Late, very hardy, and very productive.

Figured correctly in Les pl. pot., p. 314.

No. 67. Bath Cos, b. s., *Vil.*, '84.

Synonyms: Bath Green Cos, (d.), Burr; Brown Cos, Chis. trial.; Giant Brown Cos, Chis. trial.; Imperial Brown Cos, b. s. (d.), Dam.; Fr. *Romaine brune anglaise à gr. n., Vil.*, '84; Ger. Brauner Bath Binde-Salat, s. k., Vil.; Rothgrüner Englischer Binde-Salat, s. k., Vil.

Young plant rather dull deep green, the extreme borders of the inner leaves faintly tinged with light brown; leaves erosely dentate throughout, apex entire, or bluntly pointed, surface of leaves scarcely blistered, innermost leaves slightly folded upon the midrib, which is whitish green, faintly tinged with brown; veins conspicuous.

Mature plant about twelve inches in diameter. Very similar to the Bath Cos, w. s., but the leaves are a little shorter, and form a more spreading rosette, are more dentate on the borders, and form the head later; the stem is short, paniculate.

It does not always head unless tied.

Figured correctly in Les pl. pot., p. 313.

No. 68. BATH COS, w. s., *Vil.*, '84.

Synonyms: Bearfield Cos, Burr; Brown Bath Cos, Thomp.; Brown Cos, Vil.; Giant Brown Cos, w. s., Chis. trial., Imperial Brown Cos, Vil.; Sutton's Berkshire Brown Cos, Burr; Wheeler's Improved Cos, w. s., Chis. trial.; White Seeded Bath Cos, Hort. Soc.; White Seeded Brown Cos, Burr; Wood's Improved Bath Cos, Burr; FR. *Romaine brune anglaise à gr. bl. Vil.*, '84; R. d'Angleterre, Vil.; R. incomparable, Vil.; GER. Brauner Bath Binde-Salat, w. k.; Rothgrüner Englischer Binde-Salat, w. k., Vil.

Young plant clear green, the outer leaves slightly tinted with brown; leaves spatulate, the outer ones half erect, margin dentate throughout, apex entire or pointed, slightly undulate; veins brownish, midrib white above, usually somewhat speckled with red below, where it is often slightly prickly.

Mature plant eight to twelve inches in diameter; leaves nearly erect, oblong, outer leaves washed or spotted with brown, inner ones green, neither puffed nor blistered; head oblong, almost pointed, pale green, very slightly tinted with dull brown; stem smooth, rather tall, strongly washed with purplish red, paniculate, stem leaves numerous, half erect.

"Extremely hardy and succeeds well in summer and autumn. Though it heads moderately well left to itself, we are in the habit of tying it to hasten the production of tender white leaves." Vil.

Figured correctly in Les pl. pot., p. 312.

No. 69. DEER TONGUE, *Greg.*, '83.

Young plant clear green; leaves lanceolate, nearly erect, about three times as long as broad, margin erose dentate in the lower part, entire towards the summit, leaves neither puffed nor blistered, the inner ones closely folded on the midrib.

Mature plant nearly or quite eighteen inches in diameter, the longer leaves often a foot in length. It does not form a true head. The leaves spread more and more until the plant attains its full size, after which the central ones lift again inclosing the embryo flower stalk in a sort of loose imperfect head; stem very tall, much striated, often flattened, whitish green, paniculate; seeds black.

The leaves are very thick, tender and mild, and preserve their sweet flavor even after the flower stalk starts, and the lower ones have become dead.

Figured in its essential features in Bauhin's Prodromos 1671, p. 60.

No. 70. FLORENCE COS, b. s., *Vil.*, '84.

Synonyms: Golden Cos, (d.), Thomp.; *Magnum bonum Cos, d.s., Vil.*, '84; FR. *Romaine alphange à gr. n.*, *Vil.*,'85; R. Sagan, Vil.; R. Truque, Vil.; GER. Florentiner Binde-Salat s. k. (d.), Dam.

Young plant clear green, borders of inner leaves very slightly tinged brown; leaves oval, approaching spatulate, erosely dentate in the lower third, obscurely dentate above, apex entire, inner leaves somewhat blistered, with undulate borders, midribs whitish, veins not conspicuous.

Mature plant twelve to fourteen inches in diameter eight to ten inches high, pale yellowish, almost golden green; outer leaves very long and broad, very slightly tinged with light brown on the borders; inner leaves densely and finely blistered; does not form a head without tying though the inner leaves grow erect; stem often flattened, striate, sometimes tinged purple, paniculate, stem leaves nearly erect, numerous.

An excellent summer cos; very slow in running to seed, very brittle and tender in quality, and extremely productive.

As Magnum Bonum Cos mentioned by Fessenden in 1828.

No. 71. FLORENCE COS, w. s., *Vil.*, '84.

Synonyms: *Magnum Bonum Cos w. s., Vil.*, '84; FR. *Romaine Alphange à gr. bl. Vil.*, '84; GER. Ganz gelber Alphange Binde-Salat, Vil.

Closely resembes the Florence Cos, b. s. The plant is a little larger, a shade deeper green, the leaves are slightly less spreading, more compact, and less blistered; the stem is smooth, tinged purple above, the stem leaves are half erect. Like that variety, it rarely heads without tying. Its qualities are the same.

Figured correctly in Les pl. pot., p. 311.

No. 72. GOLDEN HEART, *Till.*, '84.

Synonym: Burpee's Golden Heart, (d.), Bliss.

Young plant clear green, distinctly wheelform; leaves oval or ovate spatulate, apex retuse, outer leaves strongly waved, little if any blistered, sometimes puffed below, inner leaves somewhat undulate, much puffed and blistered.

Mature plant about twelve inches in diameter, six inches high, clear glossy green, the inner leaves inclining to yellowish; head not defined, the small densely blistered inner leaves crowded in disorder, forming a rather compact bunch; outer leaves very numerous, much waved, little blistered, but very much puffed, leaves about the center nearly erect; stem often flattened, striate, paniculate, stem leaves numerous, pointing outward, strongly waved, smooth; seeds white.

A summer lettuce that is rather slow in growth and runs to seed rather early. It may be called intermediate between the Cos and cabbage lettuces.

Introduced by our seedsmen in 1884, and figured in Bliss's and Benson, Maule & Co's catalogue of that year.

No. 73. GRAY PARIS COS, *Vil.*, '84.

Synonym: Ice Parisian Cos, w. s. (d.), Dam.; FR. *Romaine grise maraîchère, Vil.*, '85; R. grise de Paris, gr. bl. (d.), Dam.; Graier selbstschliess Pariser Binde-Salat, w. k. (d.), Dam.

The young plant differs little from that of Paris White Cos, except that it is perceptibly deeper in color.

Mature plant eight to twelve inches in diameter; leaves nearly erect, forming a large, oblong head about six inches long and three inches in diameter, neatly rounded at the top, moderately compact, blanches well without tying, leaves of head spoonform, slightly blistered, but not puffed; outer leaves more coarsely blistered; stem tall, striate, often flattened, paniculate, stem leaves numerous, nearly erect, ears prominent; seeds white.

Much grown for forcing about Paris, but little cultivated in this country, though it is little inferior to the other Paris Cos lettuces.

No. 74. GREEN PARIS COS, *Vil.*, '84.

Synonyms: Ady's Fine Large Cos, Chis. trial.; Buckland Green Cos, Vil.; *Green Cos, Thorb.*, '83; Improved Paris Green Cos, (d.), Hort. Soc.; Kensington Cos, Burr; *Landreth's Heat Resisting Cos, Land.*, '84; Paris Cos, Hort. Soc.; Paris Green Cos, (d.), Bliss '83; Sutton's Superb Green Cos, Burr; Wellington Cos Burr; FR. Romaine verte maraîchére, Vil.; R. verte de Paris, (d.), Dam.; GER. Grüner selbstschliess Piriser w. k., (d.), Dam.; Pariser grüner selbstschliessender Binde-Salat, Vil.

Young plant very deep green, leaves about half erect, midribs and veins nearly white, very conspicuous; leaves broadly ovate spatulate, erose dentate except towards the apex, which is entire or retuse, usually more or less folded on the midrib, borders of inner leaves slightly undulate.

Mature plant eight to fifteen inches in diameter, and of about the same height; forming a tall, oblong, pointed or slightly obtuse head, which presents three rather well marked faces; leaves about the head erect, slightly blistered but not puffed, slightly glossy; stem tall, striate often flattened, paniculate, stem leaves numerous, nearly erect, ears very prominent; seeds white.

An excellent sort for spring, summer or autumn. It blanches well without tying; is some days earlier than the White Paris Cos, and is largely used by market gardeners about Paris for cultivating under glass.

Figured in Album de clichés.

No. 75. GREEN ROYAL WINTER, *Vil.*, '84.

Synonyms: FR. *Romaine royale verte, Vil.*, '84; R. *royale verte d'hiver, Vil.*,'84; GER. Grüner verbesserter Winter Binde-Salat, Vil.; Grüner Königs-Binde-Salat, Vil.

Young plant deep green; leaves half erect, ovate or shortly spatulate, rather deeply dentate towards the base obscurely so above, apex entire sometimes slightly pointed, borders straight except in the innermost leaves, which are often slightly puffed.

Mature plant about ten inches in diameter, and of about the same height; leaves slightly glossy, all but the outer ones nearly erect; inner leaves spreading slightly until the head commences to form, when they curve inward so as to inclose one another. Head rather tall, moderately solid; blanches tolerably well without tying; stem striate, often flattened, paniculate, stem leaves numerous, half erect; seeds black.

Differs from the Green Winter Cos in growing more erect, and in being paler and more glossy.

Figured correctly in Les pl. pot., p. 308.

No. 76. GREEN WINTER COS, *Vil.*, '84.

Synonyms; FR. *Romaine verte d'hiver, Vil.*, '84; GER. Grüner Winter Binde-Salat, Vil.; Gelber Sachsenhäuser binde-salat, Vil.

Young plant deep green; leaves roundish or obovate, margin entire except towards the base, borders of inner leaves undulate, slightly and finely blistered, veins not very conspicuous.

Mature plant ten to twelve inches in diameter, of nearly equal height; leaves very slightly glossy, shortly spatulate, curving outward, lower ones waved, all leaves more or less blistered, inner ones very finely; seeds black.

This variety does not head well unless tied. It blanches well, but the ribs and veins are rather coarse and hard. It is of little value as a summer lettuce in our climate.

Figured correctly in Les pl. pot., p. 308.

It was described by Noisette in 1828, and is called by Vilmorin a very ancient variety.

No. 77. GROUND COS, *Vil.*, '84.

Synonyms: FR. *Romaine pomme en terre, Vil.*,'84; Chicon pomme en terre, Vil.

Young plant rather deep, clear green; leaves ovate, spatulate, erose dentate except near the apex, which is retuse, midribs and veins nearly white, the former very conspicuous, borders of inner leaves slightly undulate, and their surface finely puffed and blistered.

Mature plant about eight inches in diameter; leaves deep glossy green, growing half erect, the outer leaves much waved, puffed and blistered, the inner ones somewhat folded on the midrib, much puffed, slightly blistered; stem smooth, corymbose, upper stem leaves approaching lanceolate; seeds black.

This variety forms under favorable conditions a compact head, though unless sown very early it runs to seed witout heading.

Figured correctly in Les pl. pot., p. 311.

No. 78. MONSTROUS BROWN COS, *Vil.*, '84.

Synonyms. Madeleine, Chis. trial; Magdalina, Chis. trial; Two-headed, Burr; Fr. Romaine à deux coeurs, Vil.; *R. monstrueuse, Vil.*, '84.

Somewhat intermediate in aspect between the cos and cabbage types. Young plant very vigorous, clear green, slightly washed and spotted with light brown; leaves broadly ovate spatulate, apex retuse or entire, outer leaves nearly smooth, with coarsely undulate borders, inner ones slightly blistered, borders rather finely undulate, midribs conspicuous.

Mature plant twelve inches or more in diameter, deep, dull, glossy green, more or less bronzed in places; does not head well unless tied; a few plants form a large hollow head, the outer leaves of which loosely embrace each other; inner leaves very densely, finely and prominently blistered; outer leaves slightly blistered, but not puffed; stem short, stout, striate, often flattened, much washed with purple above, rather intermediate but approaching corymbose, stem leaves broad at the base, with prominent pointed ears; seeds white.

The plant sometimes sends out side shots or suckers and occasionally produces two or more loose open heads.

No. 79. RED WINTER COS, *Vil.*, '84.

Synonyms. Blood Red Winter Cos, Vil.; Romaine rouge de Haarlem, Vil., Fr. *R. rouge d'hiver, Vil.*, '84.

Young plant dark rich red; leaves colored alike on both sides, spatulate, erose dentate except about the apex, which is entire or retuse, borders nearly plain, surface smooth, the inner leaves somewhat folded on the pinkish midrib, veins slightly depressed.

Mature plant brownish red except at the center; head tall, green except at the top, usually forms without tying; outer leaves long, rounded at the end, entire, nearly smooth; seeds black.

"The hardiness of this lettuce is its principal merit. When grown in summer it is of poor quality." Burr.

Figured correctly in Les pl. pot., p. 309.

No. 80. SPOTTED COS, b. s., *Vil.*, '84.

Synonyms. Aleppo, b.s., (d.), Burr; Bloody, b.s., Burr; *Improved Spotted Cos, b. s., Vil.*, '84 ; Red Spotted Cos, Burr ; Fr. *Romaine panachée perfectionée à gr. n.*, Vil., '84 ; Ger. Selbstschliessender, verbesserter Forellen Binde-Salat, Vil.

Young plant pale green, densely blotched and mottled with chocolate color, midribs purple, inner leaves glossy; leaves ovate, erosely dentate in the lower half, apex entire, margin straight, and surface smooth except in the inner leaves which are very slightly puffed and blistered.

Mature plant about twelve inches in diameter, eight inches high ; leaves broadly ovate spatulate, margin of inner ones undulate, surface more than half covered with reddish brown; stem smooth, deep purple, paniculate, stem leaves spotted with chocolate brown at the top, rather numerous.

This variety has formed no head at the station, though it is said by Vilmorin to head without tying.

No. 81. SPOTTED COS, w. s., *Vil.*, '84.

Synonyms. Aleppo Cos, w.s., (d.), Thomp. ; Bloody Cos, w.s., Thomp. ; *Improved Spotted Cos, w.s., Vil.*, '84 ; Fr. Romaine flagellée à gr. bl., Vil., '84; *R. panachée à gr. bl., Vil.*, '85 ; R. rouge d'Angleterre, Vil.; R. sanguine à gr. bl., Vil.; Ger. Bunter Forellen Binde-Salat, Vil.

Young plant beautifully mottled with pale green and chocolate brown, very spreading for a cos; outer leaves waved, inner ones strongly folded on the midrib, almost entirely deep rich brownish red, often glossy; leaves spatulate, coarsely erose dentate in the lower half, obscurely dentate towards the apex, which is entire or retuse, sometimes obscurely pointed; borders of inner leaves slightly ruffled, surface puffed and blistered; outer leaves nearly smooth, with undulate borders, midribs often striped with red, veins scarcely visible.

Mature plant about twelve inches in diameter and in height; upper leaves half erect, apex curving outward, lower leaves sloping downward; the whole plant much blotched and spotted with glossy reddish brown; leaves finely blistered throughout, borders much undulate, but scarcely ruffled except in the innermost leaves, which are puffed towards the base; petioles decidedly hairy below ; stem striate, sometimes flattened, paniculate, stem leaves numerous, spotted with purple.

Figured correctly in Les pl. pot., p. 313.

This is apparently a very old variety. Its name appears under its various synonyms in American garden books of 1806, 1818, 1819 and 1863; in French works of 1824, 1826 and later; in English authors of 1778, 1850, etc. It is very probably the Lactuca Romana of Mathiolus, 1568, the Lactuca rubra of Caésalpinus, 1603, and the Lactuca maculosa of Bauhin, 1623.

No. 82. WHITE PARIS COS, *Vil.*, '84.

Synonyms. *Carter's Giant White Cos, Sib.*, '85; *Giant White Cos, Sib.*, '83 ; Ice Cos, Vil. ; London White Cos, Burr ; Moorpark Cos, Vil.; Paris White Cos, Burr; Sutton's Superb White Cos, Burr; *White Cos, Thorb.*, Burr, '83; Fr. Chicon blonde, Noisette, '29; Romaine blonde de Londres à graine blanche, (d.), dam.; *R. blonde maraîchère, Vil.*, '84; Ger. Gelber Pariser Binde-Salat, Vil.; Londoner Markt Binde-Salat, w. k., (d.), Dam; Pariser gelber Selbstschliessender Binde-Salat, Vil.

Young plant clear green; leaves nearly erect, ovate spatulate, erosely dentate throughout, apex entire or bluntly pointed, inner leaves folded upon the midrib, slightly blistered, with slightly undulate borders.

Mature plant about twelve inches in diameter, nearly as high; forms a large, oblong, loose head of which the outer leaves curve distinctly inward at the top; leaves about the head somewhat blistered and folded on the midrib, borders slightly undulate; stem tall, slightly striate, often flattened, paniculate, stem leaves numerous, nearly erect; seeds white.

"This variety is certainly most cultivated of all the Cos lettuces and perhaps of all lettuces. It appears very well suited to all temperate and even to warm climates, and is prized throughout the entire world. It enjoys rich soil and abundant watering." Vil.

"Next to the Green Paris Cos, this is the best, the largest and the longest in running to seed of all the summer lettuces. It is tender, brittle and mild flavored, less hardy and a few days later than the Green Paris Cos." Burr. In our experience at the station it has not been later than several other varieties in running to seed.

Figured correctly in Les pl. pot., p. 310.

CUTTING LETTUCES.

No. 83. BOSTON CURLED, *Batch.*, '82, *Sib.*, '83.

Synonyms. Boston Market Curled, (d.), Hovey ; Curled, Burr ; Green Curled, (d.), Burr; Early Boston Curled, (d.), Ferry; Endive-leaved, Burr.

Young plant pale yellowish green; leaves broader than long, margin very irregularly dentate in its whole outline, border very intricately ruffled, usually sharply folded at the apex, which points upward; outer leaves blistered, inner ones almost covered with very small blisters, leaves much twisted and distorted, veins slightly sunken.

Mature plant nine or ten inches in diameter, having the form of a rosette. It forms no head.

"Extensively grown in the vicinity of Boston, Mass., for early marketing. It is deficient in crispness and tenderness. Its recommendations are hardiness, adaptation to early culture and forcing, and its beautiful appearance." Burr.

No. 84. Common Green Cutting, b. s., *Vil.*, '84.

Young plant clear green, remarkably vigorous; leaves nearly half erect, broadly spatulate, dentate in the lower two thirds, obscurely sinuate above, apex retuse, outer leaves smooth, inner ones puffed and blistered.

Mature plant about twelve inches in diameter, of a peculiar almost glaucous deep green; leaves very large, often ten inches long, and five inches wide, waved and blistered, very loose and spreading, the outer ones nearly half erect; plant shows no inclination to head, the outer leaves all tending to grow outward; stem tall, corymbose.

This variety is very rapid in its development, and very early runs to seed.

No. 85. Common Green Cutting, w. s., *Vil.*, '85.

Synonyms. *Crisp Small Early Cutting, w. s., Vil.*, '84; *Crisp Small Early Frame, w. s., Vil.*. '84; Fr. *Laitue blonde à couper, Vil.*, '85; Petite laitue crêpe, Vil.

Plant pale yellowish green; leaves glossy, spatulate, becoming roundish as they increase in size, puffed towards the base, borders undulate, inner ones finely blistered. If the leaves are not cut when the plant is young, the central ones fold themselves about one another, but do not form a true head; stem smooth, corymbose; seeds white. The flower stalk appears very early.

This variety is chiefly used for frame culture.

No. 86. Curled Cutting, *Vil.*, '84.

Synonyms. Small Curled Cutting, Vil.; Fr. *Laitue frisée à couper à gr. n., Vil.*,'85; Ger. Vollherziger gekrauster Schnitt Lattich, Vil.

Young plant clear green, leaves pinnately lobed, the lobes erosely dentate with ruffled borders, surface smooth, midribs greenish white, veins not conspicuous.

Mature plant about six inches in diameter, very compact, the inner leaves crumpling together, forming no defined head; leaves blanched towards the base; stem slender, short, smooth, corymbose, stem leaves cut to the top; seeds black.

Figured correctly in Les pl. pot., p. 316.

No. 87. Oak Leaved, *Hend.*, '85.

Synonyms. Fr. Laitue à carême, Vil.; L. à feuille de chêne, Vil.; L. à la reine, Vil.; L. épinard, (d.), Vil.

Young plant clear green, compact, spreading; leaves deeply and irregularly pinnately lobed, the whole width nearly equaling the length, with a long projecting rounded retuse apex, borders somewhat undulate, surface usually strongly puffed, inner leaves often folded upon the midrib.

Mature plant eight to twelve inches in diameter, very compact, forming no head, but a very dense tuft of foliage, of which the leaves appear crowded together in much disorder; inner ones very pale yellowish green; stem more or less striate, usually broad through fasciation, paniculate, stem leaves very numerous, oblong, irregularly lobed, upper ones lanceolate, with prominent pointed ears; seeds black.

Laitue èpinard is described by Noisette, 1829, and is mentioned in L'Hort. Fran., 1824. It is closely allied in the description to Laitue chicorée, and this type of lettuce appears to be the *Endivia major* of Tragus, 1552, the *Lactuca intybacea* of Tabernæmontanus, 1588, and Gerarde, 1597, and the *Lactuca folies endiviae* of Bauhin, 1623.

INDEX OF NAMES OF LETTUCES.

Synonyms are printed in italics.

The numbers refer to the numbers of the varieties in the described list.

Name	No.
Ady's Fine Large Cos	74
Aleppo	80
Aleppo Cos w. s	81
Allergrosster rothgelber Bossins Kopf-Lattich (Ger.)	5
All the Year Round b. s	1
All the Year Round w. s	65
American Curled	47
American Gathering	47
American Gathering Head	47
Asiatic	10–32
Ballon Cos	66
Bath Cos b. s	67
Bath Cos w. s	68
Bath Green Cos	67
Bearfield Cos	68
Berlin	1
Berlin White Summer	1
Berliner Gelber Kopf-Lattich (Ger.)	1
Bigotte	8
Black Seeded	7
Black Seeded Butter	10
Black Seeded Gotte	2
Black Seeded Satisfaction	1
Black Seeded Simpson	3
Black Seeded Yellow	1
Bloody	80
Bloody Cos w. s	81
Blood Red	4
Blood Red Small	4
Blood Red Winter Cos	79
Bloomsdale Butter b. s	10
Bloomsdale Early Summer	24
Bloomsdale Reliable	1
Bossin	5
Bossin's Riesen w. k. (Ger.)	5
Boston	28
Boston Curled	83
Boston Market	49
Boston Market Curled	83
Boston Market w. s	55
Brauner Bath Binde-Salat w. k. (Ger.)	68
Brauner Bath Binde-Salat s. k. (Ger.)	67
Brauner Koblenzer s. k. (Ger.)	41
Brauner fester Pariser Lattich (Ger.)	45
Brauner Faulenzer Lattich (Ger.)	41
Brauner Holländischer Kopf-Lattich (Ger.)	7
Brauner Marsailler Lattich (Ger.)	6
Brauner Winter-Lattich (Ger.)	9
Brauner Zarter Holländischer Lattich (Ger.)	7
Broei gele Latouw (Holl.)	49
Brown Batavian	6
Brown Bath Cos	68
Brown Cabbage	45
Brown Cos	68–67
Brown Dutch b. s	7
Brown Dutch w. s	8
Brown Genoa	45
Brown Silesian	6
Brown Winter	9
Brown Winter Cabbage	9
Bruine geel Lattich (Ger.)	49
Buckland Green Cos	74
Bunter Forellan Binde-Salat w. k. (Ger.)	81
Bunter Forellan Salat (Ger.)	33
Bunter Verbesserter Forellan Kopf. Lattich (Ger.)	33
Burpee's Golden Heart	72
Butter	65
Button	28
California Curled	27
California Gardner's	11
Californischer Krauser Kopf-Lattich (Ger.)	27
Capuchin	28
Carter's Giant White	31
Carter's Giant White Cos	82
Chicon Blond (Fr.)	82
Chicon pomme en terre (Fr.)	77
Commodore Nutt	12
Common Green Cutting b. s	84
Common Green Cutting w. s	85
Crisp German	13
Crisp Small Cabbage	14
Crisp Small Early b. s	14
Crisp Small Early w. s	15
Crisp Small Early Cutting	85
Crisp Small Early Frame w. s	85
Crisped Small Cabbage	14
Curled	83
Curled Beauregard	46
Curled Cutting	86
Curled German Batavian	13
Curled Silesian	18
Curled Simpson	20
Cyrius Lattich (Ger.)	59
Deacon Hine	16
Deer Tongue	69
Dippe's Emperor	17
Drumhead	40
Drumhead Cabbage	61
Dwarf Green Early b. s	60
Earliest Dwarf Green	60
Early Boston Curled	83
Early Cabbage	49
Early Curled Silesian	18
Early Curled Simpson	20
Early Dwarf Brown Forcing	19
Early Dwarf Dutch	30
Early Frame	30
Early Paris Market	49
Early Silesia	61
Early Simpson	20
Early Tennis Ball	28
Early White Spring	2

Name.	No.
Early Yellow	49
Endive Leaved	83
Ferry's Early Prize Head	47
Fine Early White Spring	2
Fine Imperial Cabbage	1
Fine Large Mogul	65
Florence Cos b. s	70
Florence Cos w. s	71
Florentiner Binde-Salat s. k. (Ger.)	70
Francfurt Head	65
Frankfort Head	65
Früher gelber Eiersalat (Ger.)	15
Früher gelber Kleiner Stein Kopf-Lattich (Ger.)	2
Früher gelber Stein Kopf-Lattich (Ger.)	14
Früher grüner fester Stein-Kopf-Lattich (Ger)	57
Ganz gelber Alphange Binde-Salat (Ger.)	71
Gelber Asiatischer Lattich s. k. (Ger.)	10
Gelber Cyrius Lattich (Ger.)	59
Gelber Faulenzer Lattich (Ger.)	35
Gelber Pariser Binde-Salat (Ger.)	82
Gelber cothkantiger Prinzenkopf Lattich (Ger.)	49
Gelber Sachsenhäuser b. s. (Ger.)	76
Gelber Simpson Lattich (Ger.)	20
Gelber von Chavigné Kopf-Lattich (Ger.)	63
Gelber von Paron Lattich (Ger.)	64
Gelber Winter Zarter Lattich (Ger.)	30
Georges	21
Geschlitzter Beauregard Kopf-Lattich (Ger.)	46
Giant Brown Cos	67
Giant Brown Cos w. s	68
Giant White Cos	82
Golden Cos	70
Golden Heart	72
Golden Spotted	22
Golden Spotted Head	22
Golden Stone Head	23
Grauer selbstschliess Pariser Binde-Salat w. k. (Ger.)	73
Gray Paris Cos	73
Gray Seeded Butter	24
Green Ball	28
Green Cabbage	30
Green Cos	74
Green Curled	83
Green Dutch	25
Green Dutch	30
Green Fat	26
Green Fringed	27
Green Paris Cos	74
Green Royal Winter	75
Green Tennis Ball	28
Green w. s	32
Green Winter Cabbage	30
Green Winter Cos	76
Green Winter of Naples	29
Grise	45
Grise paris à graine blanc (Fr.)	73
Grosser fester goldgelber Kopf-Lattich (Ger.)	36
Grosser Gelber asiatischer Lattich w. k. (Ger.)	32
Grosser gelber Berliner Lattich (Ger.).	1
Grosser gelber Berliner Königs kopf s. k. (Ger.)	1
Grosser gelber Cyrius Lattich (Ger.)	59
Grosser gelber Dauer Kopf-Lattich (Ger.)	35
Grosser gelber Harlemer Blank kopf (Ger.)	65
Grosser gelber Kopf-montrée Lattich (Ger.)	61
Grosser gelber Kopf-Salat von Neapul w. k. (Ger.)	43
Grosser gelber montrée Lattich (Ger.)	61
Grosser gelber non plus ultra w. k. (Ger.)	59
Grosser gelber Prinzenkopf Lattich (Ger.)	65
Grosser gelber Savoyer Lattich (Ger.)	59
Grosser gelber Simpson Kopf-Lattich (Ger.)	20
Grosser gelber Trommel Kopf-Lattich (Ger.)	40
Groote gele montrée latouw (Holl.)	61
Grosser grüner Leboeuf Lattich (Ger.)	37
Grosser grüner Winter Lopf-Lattich (Ger.)	39
Grosser Trommel Kopf-Lattich (Ger.).	40
Grosser Westindischer (Ger.)	10
Ground Cos	77
Grüner Königs-Binde-Salat (Ger.)	75
Grüner Feht-Salat (Ger.)	26
Grüner fester Stein-kopf-Lattich (Ger.)	57
Grüner früher Montrée Lattich (Ger.)	13
Grüner monte à peine Kopf-Lattich (Ger.)	25
Grüner selbstschliers Pariser w. k. (Ger.)	74
Grüner verbesserter winter Binde-Salat (Ger.)	75
Grüner winter Binde-Salat (Ger.)	76
Haarlemer Blank Kopf-Lattich (Ger.)	65
Haarlemer grosser gelber Lattich (Ger.)	65
Hammersmith	30
Hammersmith Hardy Green	30
Hanson	31
Hardy Green	30
Hardy Green Winter	30
Hardy Hammersmith	30
Hardy Red Winter	50
Hardy Winter Cabbage	30
Harlems' che gele Latouw (Holl.)	49
Hooper's Incomparable	61
Ice	16
Ice Cabbage	40
Ice Cos	40-82
Ice Drumhead	40
Ice Parisian Cos w. s	73
Imperial	32
Imperial Brown Cos b. s	67
Imperial Brown Cos	68
Imperial Cabbage	1
Imperial Head	32
Imperiale or Grosse Allemande	32
Improved Paris Green Cos	74
Improved Spotted w. s	33
Improved Spotted Cabbaging	33
Improved Spotted Cos b. s	80
Improved Spotted Cos w. s.	81
India Head	47
Intermediate Leboeuf	37
Kensington Cos	74
Krauser Amerikanischer Pflück Lattich (Ger.)	47
Krauser Deutscher Kopf montrée Kopf-Lattich (Ger.)	13
Laciniated Beauregard	46
Lactuca intybacea	87
Lactuca folies endiviae	87
Laitue à bord rouge (Fr.)	49
—— *à carême* (Fr.)	87
—— *à couper frisée d'Australie* (Fr.)	20
—— *à feuille de chêne* (Fr.)	87
—— *à la reine* (Fr.)	87
—— *Allemande* (Fr.)	20
—— *Babiane* (Fr.)	39
—— *Bapaume* (Fr.)	41
—— *Batavia à bord rouge* (Fr.)	61
—— *Batavia blonde* (Fr.)	61
—— *Batavia brune* (Fr.)	6
—— *Batavia frisée allemande* (Fr.)	13
—— *Batavia Italienne* (Fr.)	13
—— *Beauregard* (Fr.)	46
—— *Beauregard à feuille laciniée* (Fr.)	46
—— *Berg-op-Zoom*	41
—— *Besson* (Fr.)	48

Name.	No.
Laitue blonde (Fr.)	65
—— *blonde dorée* (Fr.)	47
—— *blonde à Couper* (Fr.)	85
—— *blonde à graine noire* (Fr.)	1
—— *blonde de Berlin* (Fr.)	1
—— *blonde de Boulogne* (Fr.)	62
—— *blonde de Chavigné* (Fr.)	63
—— *blonde d'été* (Fr.)	65
—— *blonde d'été de Saint Omer* (Fr.)	35
—— *blonde de Paron* (Fr.)	64
—— *blonde de Tours* (Fr,)	1
—— *blonde de Versailles* (Fr.)	59
—— *blonde royale à graine blanche* (Fr.)	59
—— *Bossin* (Fr.)	5
—— *Bossin très grosse* (Fr.)	5
—— *Bordelande* (Fr.)	49
—— *brune d' achicourt* (Fr.)	45
—— *brune d' Arras* (Fr.)	45
—— *brune d' hiver* (Fr.)	9
—— *brune d' hiver des Carmes* (Fr.)	39
—— *brune de Silésie* (Fr.)	6
—— *brune hollandaise* (Fr.)	45
—— *chicorée* (Fr.)	87
—— *chou* (Fr.)	6
—— *chou blonde* (Fr.)	40
—— *chou de Naples* (Fr.)	43
—— *cordon rouge* (Fr.)	49
—— *crêpe blonde* (Fr.)	15
—— *crépe à graine blanche* (Fr.)	15
—— *crêpe à graine noire* (Fr.)	14
—— *crêpe hâtive* (Fr.)	14
—— *crêpe petite* (Fr.)	14
—— *d'Alger à graine noire* (Fr.)	10
—— *d' aubervilliers* (Fr.)	28
—— *d' Australie* (Fr.)	47
—— *de Hollande* (Fr.)	41
—— *de La Passion* (Fr.)	39
—— *de Malta* (Fr.)	40
—— *d'ognon* (Fr.)	55
—— *de Russie* (Fr.)	10
—— *de Silésie* (Fr.)	61
—— *de Trocadéro* (Fr.)	38
—— *de Versailles* (Fr.)	59
—— *doreé d' Amerique* (Fr.)	47
—— *épinard* (Fr.)	87
—— *flagella* (Fr.)	58
—— *frisée à couper à graine noire* (Fr.)	86
—— *frisée à couper Beauregard* (Fr.)	46
—— *frisée d' Amerique* (Fr.)	47
—— *frisée de California* (Fr.)	27
—— *Gapillard* (Fr.)	65
—— *gau* (Fr.)	55
—— *Georges* (Fr.)	21
—— *George blanche* (Fr.)	21
—— *glacée* (Fr.)	20
—— *gotte à graine blanche* (Fr.)	55
—— *gotte à graine noire* (Fr.)	2
—— *gotte lente à monter* (Fr.)	57
—— *gotte verte hâtive* (Fr.)	28
—— *grise maraîchère* (Fr.)	41
—— *grosse* (Fr.)	10
—— *grosse allemande* (Fr.)	10
—— *grosse blonde d'hiver*)Fr.)	36
—— *grosse blonde paresseuse* (Fr.)	35
—— *grosse brune d'hiver* (Fr.)	9
—— *grosse brune paresseuse* (Fr.)	41
—— *grosse grise* (Fr.)	41
—— *grosse hollandaise* (Fr.)	7-41
—— *grosse Normande* (Fr.)	34
—— *hâtive de Silésie* (Fr.)	18
—— *hâtive de Simpson* (Fr.)	20
—— *impériale* (Fr.)	32
—— *incomparable* (Fr.)	45
—— *incomparable à graine noire* (Fr.)	10-32
—— *jaune de Harlem* (Fr.)	65
—— *jaune d'été* (Fr.)	65
—— *jeune brune* (Fr.)	45
—— *julienne d'été* (Fr.)	11
—— *Le boeuf* (Fr.)	37

Name.	No.
Laitue maraîchère (Fr.)	38
—— *merveille des quatre Saisons* (Fr.)	48
—— *méterelle (a Bordeaux)* (Fr.)	41
—— *monte à peine à graine blanche* (Fr.)	8
—— *monte à peine verte à graine noire* (Fr.)	25
—— *morine* (Fr.)	30
—— *mortatella* (Fr.)	42
—— *mousselme rouge* (Fr.)	48
—— *nain vert très hâtive* (Fr.)	60
—— *nonpareille* (Fr)	35-65
—— *oeil-de-perdrix* (Fr.)	45
—— *Palatine* (Fr.)	45
—— *Palatine rousse* (Fr.)	45
—— *panachée* (Fr.)	58
—— *paresseuse du Pas-du-Calais* (Fr.)	11
—— *passion* (Fr.)	39
—— *passion d'hiver* (Fr.)	39
—— *petite brune* (Fr.)	45
—— *petite crêpe* (Fr.)	14
—— *petite noire* (Fr.)	14
—— *pommée du paresseuse* (Fr.)	65
—— *pommée Texas* (Fr.)	47
—— *pommée de Zéalande* (Fr.)	65
—— *prodigieuse* (Fr.)	41
—— *rouge d'hiver* (Fr.)	50
—— *roulette* (Fr.)	2
—— *roulette d'été à graine noire*(Fr.)	45
—— *rousse* (Fr.)	45
—— *rousse hollandaise* (Fr.)	7
—— *rousse hollandaise à graine blanche* (Fr.)	8
—— *royale à graine blanche* (Fr.)	65
—— *royale à graine noire* (Fr.)	1
—— *sanguine à graine blanche* (Fr.)	58
—— *sanguine améliorée* (Fr.)	33
—— *tennisball* (Fr.)	28
—— *tête de mort* (Fr.)	61
—— *truite* (Fr.)	58
—— *turque* (Fr.)	10
—— *verte grasse* (Fr.)	26
Landreth's Forcing	60
Landreth's Heat Resisting Cos	74
Large Brown Cabbage	41
Large Brown Coblenz b. s	41
Large Butterhead	10
Large Drumhead	61
Large Green	35
Large Green b. s	41
Large Green Head or Cabbage	61
Large Green Pas-de-Calais	10
Large Gray Cabbage	41
Large Mogul	59
Large Normandy	34
Large White Cabbage	65
Large White Stone Summer	35
Large White Versailles	59
Large White Winter	36
Large Winter	9
Large Winter Cabbage	39
Large Winter Maderia	39
Large Winter w. s	39
Large St. Angelo	43
Large Versailles	59
Large Yellow Butter	10
Large Yellow Butter—Gray seed	24
Large Yellow Cyrius	59
Large Yellow Prince's Head w. s	65
Large Yellow Seeded Normandy	34
Late White Cabbage	65
Latughe verde (Italian)	30
Le boeuf	37
Leyden White Dutch Cabbage	1
Londoner Markt Binde-Salat w. k. (Ger.)	82
London White Cos	82
Lorthois	38
Madeleine	78
Maderia	39
Magdalina	78

Name.	No.
Magnum Bonum Cos b. s	70
Magnum Bonum Cos w. s	71
Malta	40
Malta Drumhead	40
Malta Large Drumhead	40
Mammoth	41
Marsailles Cabbage	6
Marvel	48
Milan	44
Mogul	41
Mogul Lattich (Ger.)	59
Monstrous Brown Cos	78
Moorpark Cos	82
Mortatella	42
Mortatella Cabbage	42
Munson's Perfection	20
Naples Cabbage	43
Neapolitan	43
Neapolitan Cabbage	43
Neapolitanischer Dauer Kopf-Lattich (Ger.)	43
Negrohead	44
Nellis' Perpetual	20
New American	47
New American Gathering	47
New Giant of Salermo	43
New Golden Spotted	22
New Orleans Cabbage	10
New Perpetual	20
New Silver Ball	64
New Summer Cabbage	5
Nonpariel	35
Non Plus Ultra w. s	59
Oak Leaved	87
O. K. Golden Head	23
Palatine	45
Paper White Curled	27
Pariser gelber selbstschliessender Binde-Salat (Ger.)	82
Paraiser grüner selbstschliessender Binde-Salat (Ger.)	74
Paris Cos	74
Paris Green Cos	74
Paris White Cos	82
Pelletier	46
Perpetual	20
Perpignon	65
Petite laitue crêpe (Fr.)	85
Prince Albert	61
Prince's Head	65
Princess	65
Prize Head	47
Prussian Cabbage	30
Red Beson	48
Red Bordered	49
Red Edged	49
Red Edged Drumhead	61
Red Edged Victoria	49
Red Spotted Cos	80
Red Winter Cos	79
Red Winter Cabbage	50
Rochester Cabbage	23
Roman Cabbage	30
Romaine à deux coeurs	78
—— *Alphange à graine blanche* (Fr.)	71
—— *alphange à graine noire* (Fr.)	70
—— *balon* (Fr.)	66
—— *blonde maraîchère* (Fr.)	82
—— *blonde Londres gr. bl.* (Fr.)	82
—— *brune anglaise à graine blanche* (Fr.)	68
—— *brune anglaise à graine noire* (Fr.)	67
—— *d' Angleterre* (Fr.)	68
—— *de Bougival* (Fr.)	66
—— *flagellée à graine blanche* (Fr.)	81
—— *grise maraîchère* (Fr.)	73
—— *incomparable* (Fr.)	68
—— *monstrueuse* (Fr.)	78
—— *panacheé à graine blanche* (Fr.)	81
—— *panachée perfectionée à graine noire* (Fr.)	80
—— *pomme en terre* (Fr.)	77
Romaine rouge d' Haarlem (Fr.)	79
—— *rouge d' hiver* (Fr.)	79
—— *rouge d' Angleterre* (Fr.)	81
—— *rouge dorée* (Fr.)	47
—— *royale verte* (Fr.)	75
—— *royale verte d'hiver* (Fr.)	75
—— *Sagau* (Fr.)	70
—— *sanguine à graine blanche* (Fr.)	81
—— *Turque* (Fr.)	70
—— *verte d'hiver* (Fr.)	76
—— *verte Maraîchère* (Fr.)	74
—— *verte de Paris* (Fr.)	74
Roquette	51
Rothbrauner Beson odor Wonder Kopf-Lattich (Ger.)	48
Rothgrüner Englisher Binde-Salat s. k. (Ger.)	67
Rothgrüner Englisher Binde-Salat w. k. (Ger.)	68
Rother fester Winter Kopf-Lattach (Ger.)	50
Royal w. s	65
Royal or White Summer	1
Royal verte d'hiver (Fr.)	75
Russian or Butter	10
Salamander	1
Satisfaction Black Seeded	1
Satisfaction w. s	40
Saxony	65
Sehr früher fester Stein Kopf-Lattich (Ger.)	55
Sehr früher gelber fester Stein Kopf-Lattich (Ger.)	55
Selbstschliessender verbesserter Forellan Binde-Salat (Ger.)	80
Shotwell's Brown Head	52
Silber Kopf-Salat (Ger.)	32
Silesian	61
Silberball d'hiver gris argentea w. s. (Fr.)	64
Silberball neuer Winter w. k. (Ger.)	64
Silver Ball New Winter	64
Simpson's Early Curled	20
Simpson's Silesia	20
Small Curled Cutting	86
Small dark Red	33
Spanish	61
Spater gelber montrée w. k. (Ger.)	61
Spotted Cos b. s	80
Spotted Cos w. s	81
Stone Head Golden Yellow	53
Stone Tennis-ball	51
Sugar	65
Sugar Loaf	54
Superfine New French	41
Sutton's Berkshire Brown Cos	68
Sutton's Superb Green Cos	74
Sutton's Superb White Cos	82
Swedish	65
Tennis Ball	28
Tennis Ball b. s	28
Tennis Ball w. s	55
Texter	1
The Deacon	56
The Favorite	5
Tom Thumb	57
Trout	58
Turkish	10
Turkey Cabbage	10
Two-Headed	78
Union	32
Versailles	59
Versailles Cabbage	59
Very Early Dwarf Green	60
Very Large Bossin	5
Very Large Yellow Parasseuse	35
Victoria	49
Victoria Cabbage	54
Vilmorin's grüner Feht s. k. (Ger.)	26
Vollherziger gekrauster Schnitt Lattich (Ger.)	86
Ward's Improved White Tennis Ball	49
Wellington Cos	74

Name.	No.	Name.	No.
Wheeler's Improved Cos	68	White Paron	64
Wheeler's Tom Thumb	57	*White Paron Cabbage*	64
White Batavian	61	*White Seeded Bath Cos*	68
White Berlin Summer	1	*White Seeded Brown Cos*	68
White Boulogne	62	*White Seeded Gotte*	55
White Cabbage	35–40	*White Seeded Tennis Ball*	55
White Chavigne	63	*White Silesian*	40–61
White Cos	82	White Summer	65
White Dutch	49	*White Summer Cabbage*	65
White Forcing Head	55	*White Tennisball w. s*	55
White Gotte b. s	2	*Winter Kopf-Lattich* (Ger.)	48
White Gotte w. s	55	*Wood's Improved Bath Cos*	68
White Nonpariel	40	*Yellow Egg Frame*	15
White Paris Cos	82	*Yellow Seeded Butter*	24

CELERY.

Seeds of the following list of celeries were planted in boxes in the cold frame April 10, and thirty plants of each were transplanted to the garden July 8th. The plants were set six inches apart, in drills prepared in the manner noted for the melon. With the exception of the Improved White Plume, all were banked up about the middle of September. The Golden Yellow (*Fr. plein blanc doré*) proved however to be nearly or quite self blanching, as was indicated by the inner leaves whitening clear to the tips. It is probable that the banking was detrimental to the keeping of this variety.

The average length of the blanched stems, and the weight, calculated on the basis of one hundred plants were as follows:

Celery.	Average length of blanched stalks in inches.	Weight per hundred plants.
		lbs. oz.
Boston Dwarf White	14	171– 7
Boston Market (Breck)	9	68–12
" " (Everitt)	12	140– 6
Crawford's Hlf. Dwf. White	10	140– 5
Early Arlington	10	127–12
Giant White Solid	11	134– 8
Golden Yellow (Fr. plein blanc doré)	8	100– 0
Henderson's Dwf. White	9	103– 2
Henderson's Half Dwarf	12	136– 3
Henderson's New Rose	10	94–13
Improved White Plume	8	145– 2
Incomparable Dwarf Crimson	11	90– 0
New Golden Heart Half Dwarf	10	118–14
Perfection Heartwell	11	136–10
Sandringham Dwarf White	11	120–13
Sealey's Leviathan	16	110– 3
White Skaget	11	70– 3
White Walnut	12	70– 3

All the varieties blighted considerably except the Improved White Plume, Thor., '85 and the Boston Dwarf White, from same source. The latter blighted slightly. It is possible that the unnsually warm weather of late autumn acted detrimentally upon the banked plants, causing the foliage to blight more than it otherwise would have done.

The Boston Dwarf White, Thor., '85 was a very vigorous growing variety with thin leaf-stalks, which were frequently hollow. It blanched well, and gives promise of being a good keeper, but was indifferent in flavor. This variety is very distinct from the Boston Market.

The Improved White Plume, Thor.,'85 closely resembled the Henderson's White Plume, Hen., '84 but we think it was rather more vigorous. We grew the Henderson's White Plume, but not in a way to make it comparable with this. The stems of both blanched well without banking, were very broad and thick at the base, but short. In quality they were very crisp, but by no means as tender as those of the blanched varieties, yet not sufficiently tough to make them unpleasant eating. The flavor was more decided and less mild than of the blanched white varieties, but free from pungency or bitterness. As will appear from the table, the Improved White Plume was surpassed in productiveness by but one variety, viz. the Boston Dwarf White. Incomparable Dwarf Crimson, Thor., '85, blighted rather less than the white varieties. In flavor it seemed to us rather superior, being what might be called high flavored, but without the least rankness or bitterness. The stems were rather lacking in crispness, but were very tender.

Henderson's New Rose, Hen., '85 was of excellent flavor, tender, and we judge will keep well. Like the above the stems were rather lacking in crispness.

Sealey's Leviathan, Vick, '85 was a very vigorous grower, but we judge it will prove a poor keeper, as the stems were considerably decayed when harvested (Nov. 4).

The Golden Yellow (*Fr. plein blanc doré*), Vil. '85 had attractive cream colored, rather slender stems which were crisp and mild flavored.

With the exception of the Boston Market, Boston Half Dwarf, and Sealey's Leviathan, the differences between the other white celeries seemed to us quite obscure. Indeed there was more difference between the plants of the Boston Market from the two sources noted in the table, than between any of the white varieties, other than the three just named. It is possible however that were we to permit the plants to produce seed, more perceptible differences would appear.

PEPPER.

Seeds of the following peppers were planted in boxes in the greenhouse Apr. 7, and eleven plants of each, with a few exceptions, were transplanted to the garden June 8. The rows were three and a half feet apart, and the plants were set one foot apart in the row.

The following data were noted:

Pepper.	First bloom.	Days from planting.	First fruit ripe.	Days from planting.
Buttercup	July 20	104	Sept. 21	167
Cherry (Thor.)	" 13	97	" 18	164
" (Vil.)	" 20	104	" 18	164
Chili	" 13	97	" 7	153
Crimson Queen	" 17	101	" 25	171
Large Squash	" 20	104		
Long Red	" 20	104		
Long Yellow	" 17	101	Oct. 1	177
Monstrous (Thor.)	" 27	111		
" (Vil.)	" 27	111		
New Cranberry	" 20	104	Sept. 7	153
Red Prince	" 13	97	" 7	153
Sweet Spanish (Thor.)	" 23	107	Oct. 9	185
" " (Vil.)	" 20	104	" 9	185
Tomato shaped or Red Squash	" 22	106		

It will appear that none of the varities ripened early, and that five failed to ripen.

Synonyms.

The Buttercup, Everitt,'85, was undoubtedly the same as the Sweet Golden Dawn, Thor., '83.

The Crimson Queen, Till., '85, answered to the description of the Monstrous (*Fr. monstreuse*), Vil., '84.

The Red Prince, Everitt, '85, was the same as the Sweet Spanish, Vil., '85.

The Large Squash, Thor.,'83, was the same as the Tomato Shaped, or Red Squash (*Fr. tomate rouge*), Vil., '84.

TOMATO.

A test of Varieties.

We planted seeds of fifty-one differently named tomatoes in boxes in the greenhouse April 4, and transplanted four plants of each to the garden June 3. All but ten of these had previously been grown at the Station. The dates of the first ripe fruit, and of the first ten ripe fruits of each are given in the following table.

TOMATO—A TEST OF VARIETIES.

	First bloom	Days from planting.	First fruit ripe.	Days from planting.	Ten fruits ripe.	Days from planting.
Alpha	June 16	73	Aug. 6	124	Aug. 12	130
Arlington	“ 20	77	“ 13	131	Sept. 1	150
Boston Market	“ 26	83	“ 18	136	Aug. 24	142
Cardinal	“ 22	79	Sept. 1	150	Sept. 19	168
Currant	“ 18	75	Aug. 7	125	Aug. 10	128
Early Conqueror	“ 18	75	“ 8	126	“ 15	133
Early Richmond	“ 20	77	“ 13	131	“ 21	139
Early York	“ 16	73	“ 4	122	“ 15	133
Emery	“ 26	83	“ 29	147	Sept. 4	154
Essex Early Hybrid	“ 24	81	“ 17	135	“ 1	150
Essex Round Red Smooth	“ 26	83	“ 14	132	Aug. 25	143
Extra Early Red	“ 22	79	“ 18	136	“ 26	144
Fejee Island	“ 22	79	“ 25	143	Sept. 18	167
Fulton Market	“ 16	73	“ 13	131	Aug. 19	137
General Grant	“ 20	77	“ 10	128	“ 30	148
Golden Trophy	“ 16	73	“ 4	122	“ 29	147
Hathaway's Excelsior	“ 20	77	“ 22	140	Sept. 12	161
Howard	“ 20	77	“ 19	137	“ 5	154
Hubbard's Curled Leaf	“ 16	73	“ 7	125	Aug. 19	137
Hundred Day	“ 18	75	“ 8	126	“ 19	137
Improved Large Yellow	“ 26	83	“ 19	137	Sept. 9	158
Jones' Early Hybrid	“ 22	79	“ 27	145	“ 1	150
Keyes' Early Prolific	“ 18	75	“ 17	135	Aug- 19	168
King Humbert	“ 26	83	“ 22	140	“ 24	142
Large Red	“ 22	79	“ 12	130	“ 22	140
Large Red Smooth Round	“ 20	77	“ 19	137	“ 27	145
Large Yellow	“ 20	77	“ 19	137	“ 29	147
Livingston's Acme	“ 22	79	“ 17	135	“ 31	149
Livingston's Favorite	“ 27	84	“ 25	143	Sept. 1	150
Lyman's Mammoth Cluster	“ 22	79	“ 29	147	“ 3	152
Mayflower	“ 20	77	Sept. 1	150	“ 14	163
Mexican Mammoth	“ 24	81	“ 19	168	“ 25	174
Nesbit's Victoria	“ 22	79	Aug. 13	131	Aug. 14	132
New Japanese	“ 20	77	“ 31	149	Sept. 3	152
New Red Apple	“ 20	77	“ 7	125	Aug. 29	147
New White Apple	“ 22	79	“ 17	135	Sept. 5	154
New York Market	“ 20	77	“ 14	132	Aug. 29	147
Optimus	“ 20	77	“ 14	132	“ 27	145
Orangefield	“ 20	77	“ 19	137	“ 22	140
Pear	“ 18	75	“ 31	149	Sept. 3	152
Perfection	“ 26	83	“ 25	143	“ 19	168
Powell's	“ 24	81	Sept. 1	150	“ 5	154
Precursor	“ 24	81	Aug. 22	140	“ 1	150
President Garfield	“ 24	81	--------	----	“ 21	170
Queen (Fer.)	“ 22	79	Aug. 17	135	“ 3	152
Queen (Hen.)	“ 22	79	Sept. 1	150	“ 5	154
Reade's Island Beauty	“ 24	81	Aug. 17	135	“ 19	168
Red Chief	“ 22	79	“ 27	145	“ 17	166
Red Valencia Cluster	“ 24	81	“ 26	144	“ 19	168
Rochester	“ 22	79	“ 15	133	Aug. 29	147
The Favorite	“ 24	81	“ 29	147	Sept. 21	170
Tilden's New	“ 20	77	“ 17	135	Aug. 22	140
Triumph	“ 22	79	“ 29	147	Sept. 15	165
Yellow Cherry	“ 18	75	“ 7	125	Aug. 13	131
Yellow Plum	“ 18	75	“ 6	124	“ 13	131
Yellow Victor	“ 18	75	“ 10	128	“ 17	135

It appears that the Early York and Golden Trophy were the earliest two varieties, each ripening its first fruit on Aug. 4, or 122 days from planting. The Alpha was the first large fruited variety to ripen ten fruits.

We noted in our last report that the time of maturity of the different varieties of the tomato is by no means constant. As an illustration of this we place in three separate tables, the number of days from planting to the time when the first ten fruits were ripe, in twenty-two so-called varieties, for three seasons, viz: 1883, 1884 and 1885. The names in each table are placed in the order in which they ripened the first ten fruits, those inclosed in brackets having been marked on the same day:

1883.	
Yellow Victor	136
Conqueror	140
General Grant	140
Hubbard's Curled Leaf	140
Early York	143
Hundred Day	143
Orangefield	143
Reade's Island Beauty	143
Pear	147
Tilden's New	147
Triumph	147
New White Apple	148
Red Chief	148
Powell's	159
Red Valencia Cluster	159
Livingston's Favorite	162
Arlington	164
Lyman's Mammoth Cluster	164
Golden Trophy	166
Rochester	169
Feegee Island	170
New Japanese	187

1884.	
Early York	139
Hundred Day	139
Conqueror	143
Orangefield	143
Hubbard's Curled Leaf	144
Yellow Victor	147
Tilden's New	147
Pear	148
Red Chief	150
Powell's	150
Livingston's Favorite	150
New Japanese	150
Arlington	151
General Grant	151
Lyman's Mammoth Cluster	151
Triumph	151

1884

New White Apple	152
Rochester	152
Red Valencia Cluster	152
Golden Trophy	157
Feegee Island	157
Reade's Island Beauty	157

1885.

Conqueror	133
Early York	133
Yellow Victor	135
Hubbard's Curled Leaf	137
Hundred Day	137
Orangefield	140
Tilden's New	140
Golden Trophy	147
Rochester	147
General Grant	148
Arlington	150
Lyman's Mammoth Cluster	152
New Japanese	152
Pear	152
New White Apple	154
Powell's	154
Triumph	165
Red Chief	166
Feegee Island	167
Red Valencia Cluster	168
Reade's Island Beauty	168
Livingston's Favorite	170

An examination of the tables show a singular want of uniformity. For example, in 1883 the Conqueror and Gen. Grant had ten fruits ripe on the same day. In 1884 the Conqueror was at this stage eight days earlier than the Gen. Grant, and in 1885 fifteen days earlier. Other still more striking incongruities appear.

Effects of Using Immature Seed.

In our last report we noted that seed of the Cook's Favorite tomato taken from very immature fruit, gave a small percentage of vegetation, and the plants were feebler in growth, and ripened their fruits considerably earlier than those from mature seed. This experiment was repeated the past season with the Livingston's Favorite with a similar result. In order to intensify the influence of using immature seed, we gathered last season the seeds from very immature fruits taken from the plants secured from the very immature seed of 1883. This seed was planted last spring, and again vegetated very poorly. The plants were very feeble in growth from their first appearance, and attained but little size. The first fruit on them ripened on the same day as on the plants of the same variety grown from mature seed; but the first ten fruits were ripe a week in advance of those from the mature seed.

The foliage assumed a peculiar rolled or shrivelled appearance, and early commenced to blight. The fruit was diminutive in size, and as the season advanced a large part of it decayed with a soft rot, without showing any of the symptoms of the black rot that so often effects our tomatoes.

It is an interesting coincidence that the peculiar shrivelled foliage, the dwarfed plant and the inclination to blight in the leaves, and decay in the fruit just noted, is a characteristic in a greater or less degree of several of our earlier tomatoes, notably the Hubbard's Curled Leaf, Early York, and Hundred Day, and in less degree in the Extra Early Red, Early Conqueror, Alpha, Early Richmond, Keyes' Early Prolific and General Grant. The query is suggested whether these varieties may not have originated from the use of immature seed. As these varieties are among the very earliest of the large fruited tomatoes, the coincidence is striking. We find in endeavoring to secure earliness from the results of cross-fertilization, that selecting the earliest fruit for three generations does not result in feeble growth or shrivelled foliage, but in small few-celled, roundish or oblong fruit. We have been told by the growers of tomato seed that this is the tendency. If these varieties have been produced by the use of immature seed, it would seem that the efforts, whether intentional or otherwise, were made in a direction that proves very detrimental to the health of the plants, and to the size and keeping quality of the fruits.

Observations on the Tomato Rot.

An unusually large proportion of our tomatoes rotted the past season. The first appearance of the affection was noted Aug. 6, and it apparently continued to increase until frost. The nature of this disease, if it be a disease, is perplexing, as the symptoms vary much in different seasons. It is possible that two or more diseases are confounded under the common name, "tomato rot." The symptoms of the disease the past season did not seem to be the same as those described in our report of 1882, and Prof. Arthur thinks that they were not the same as those of the disease described by him in the Station report of 1884. Whatever the disease may be, it is probably of fungus origin.

So far as our observation extended, it seemed to flourish most on the more vigorous plants. On Sept. 23, a vigorous plant of Cook's Favorite tomato, grown from mature seed had eighteen per cent. of its fruits affected with the black rot, while the feeble one, grown from immature seed, had but five per cent. of its fruits affected. Two plants of the Acme, grown from seed from a fruit destroyed by the rot in 1884, had Sept. 24th, twenty-seven per cent. of their fruits affected; while two plants from the seed of apparently healthy fruits had twenty-two per cent. of affected fruits. Did we know that the disease of 1884 and 1885 were the same, this would indicate that it does not depend upon the infection of the seed, but as we do not know this fact, we are none the wiser.

Synonyms.

We have studied our varieties of tomato the past season with unusual care for the purpose of discovering the synonyms among them.

We have no hesitation in saying that certain varieties have a very close resemblance, but in declaring which are synonyms we speak with less confidence than in other vegetables. We note with some hesitation the names that appeared to us the same, but we desire to grow them another season before speaking confidently. We shall be glad of any information that will aid in settling the perplexing question of synonyms in the tomato. The following at present seem to be identical :

Arlington, Greg., 1883, and Howard, Greg., 1883.

Boston Market, Greg., 1883, and Fulton Market, Till., 1885.

Cardinal, Greg., 1884, and Queen, Fer., 1884.

Early Richmond, Land.,1885, and Precursor, B. M. & Co., 1884.

Early York, Greg., 1883, and Hubbard's Curled Leaf, Sib.,1883.

Emery, Far., 1885, and Mayflower, Sib., 1885.

Essex Round Red Smooth, Greg., 1885, and Tilden's New, Greg., 1883.

Favorite, Greg., 1885 ; Hathaway's Excelsior, Sib., 1885; Livingston's Favorite, Greg., 1883; New Red Apple, Greg.,1884, and Optimus, Fer., 1885.

Golden Trophy, Thor., 1883, and Yellow Victor, Greg., 1883.

Large Red, Fer., 1883; Large Red Smooth Round, Sib., 1883, and New York Market, Hen., 1884.

Queen, Hen., 1884, and Red Valencia Cluster, Thor., 1883. (The Queen of Ferry and Henderson were quite distinct.)

Reade's Island Beauty, Thor., 1883, and Triumph, Greg., 1883.

We had formerly considered the Acme and Essex Early Hybrid the same, and so stated in our last report. The past season, however, a rather marked difference appeared between them, the latter being more vigorous, later and bearing rather larger fruits.

All of the other varieties seemed to us distinct.

Cross-fertilizations.

The erect, tree form of the French Upright or Tree tomato, (*tomate de Laye*, of the French), is more desirable in some respects than the spreading decumbent habit of the ordinary garden tomato. The plants do not require trellising, the fruits are borne where they are in full view, and rarely touch the ground, the thick foliage and strong stem cause the plants to endure transplanting better than those of the common tomato, and most important of all the compact form of this variety adapts it for growing in frames for forcing. The objection to it is that it is so late as to scarcely ripen unless the season is unusually favorable.

During the past three seasons we have been endeavoring, by cross-fertilizing this variety with different sorts of the common tomato, to secure an early variety having the upright habit. In 1883, we secured several crosses between the French Upright and Alpha, and French Upright and Livingston's Favorite tomatoes, and in '84 we crossed successfully the French Upright with the Acme.

The results of these crosses have been quite interesting, in a scientific point of view, and we hope also quite successful in securing the object sought.

Thus far the habit of the common tomato has predominated in the plants grown from the crossed seed. The first planting from the crosses with the Alpha and Livingston's Favorite gave but one plant with the Upright habit, to a hundred or more of the common form, and this plant was so late that it ripened no fruit. We gathered several of the earliest ripening fruits from plants having the ordinary habit, however, and from the seeds of these obtained many plants of the Upright habit. One of the latter lot of plants was of very compact form, being scarcely more than one and a half feet in height, and eight inches in diameter, and ripened its first fruit as early as the earliest named variety in the garden. In case we succeed in fixing the character of this plant, we shall have attained our object.

The cross between the French Upright and Acme, made in 1884, yielded in the first planting a much larger proportion of plants of the Upright type, than did the crosses with the Alpha and Livingston's Favorite.

We find that selecting only smooth fruits through three generations, from a cross between the Turk's Cap or Turban tomato and the Acme, and other large smooth sorts, made in 1882, seems to have bred out all influence of the Turk's Cap parent, so far as form is concerned.

An Experiment with the Earliest and the Latest Germinating Seeds.

It is well known that the seeds of a given planting do not usually all germinate or vegetate on the same day. In order to discover whether any relation exists between the time of germination, and the time of maturity of the fruits in the tomato, we selected four plants of the Mayflower variety, of which the seed germinated the fourth day, and four others of which the seed germinated the thirteenth and fourteenth days after placing in the seed pan. The plants of each lot were set out in the garden June 3rd. The first ripe fruits on each lot appeared September 5, but the first ten ripe fruits appeared four days earlier on the plants that germinated latest. The results are as nearly uniform as we could expect in duplicate plantings.

Is the Number of Cells in the Tomato Influenced by Heredity?

We repeated the experiment made in 1884 of planting seeds of the Early Red Smooth tomato from three-celled and six-celled fruits respectively, with a similar result. Fifty fruits gathered at random from the plants grown from three-celled fruits contained 158 cells, while an equal number from plants grown from six-celled fruits contained 259 cells. As few celled fruits seem more likely to be smooth than many celled ones, it is possible that an advantage is to be gained by selecting few celled fruits for seed.

PEA.

Of the pea we grew thirteen varieties, or names of varieties—not previously grown at the station, and such others as we desired for further study, or for comparison with the later introductions.

All but two were planted April 24, viz., the "Blue Wrinkled Dwarf" and "Yellow Wrinkled" from Dr. T. H. Hoskins of Newport, Vt., two new varieties, which we believe are not yet permanently named. These were planted May 22, and hence are not comparable with the others. One row of each name, twelve feet long was planted ; the seeds placed three inches apart, the rows seven feet apart. All were bushed that grew sufficiently tall to require it.

The names and the data noted are as follows :

PEA. Wrinkled Sorts in Italics.	First bloom.	Days from planting.	Pods of edible size.	Days from planting.	Days fit for table use.	First seeds ripe.	Days from planting.	Last seeds ripe.	Days from planting.	Number of pods per 100 plants.	Number peas in 100 average pods.
Bennett's Green Prolific.	June 18	55	July 1	68	12	July 18	85	July 28	95	488	533
Bennett's Market	" 18	55	" 6	73	12	" 20	87	Aug. 8	106	460	466
Black Eyed Marrowfat.	" 26	63	" 10	77	17	" 25	92	" 1	99	704	424
Bliss' Abundance	" 16	53	June 30	67	13	" 17	84	July 29	96	620	420
Blue Imperial	" 18	55	" 5	72	12	" 21	88	Aug. 1	99	636	344
Blue Wrinkled Dwarf	" 22	31	July 11	50	9	" 25	64	" 8	78	540	435
Caractacus	" 8	45	June 29	66	16	" 15	82	July 28	95	608	542
Carter's First Crop	" 3	40	" 20	57	10	" 6	73	" 10	77	784	483
Carter's Strategem	" 18	55	July 8	75	12	" 20	87	Aug. 1	99	780	646
Cleveland's Improved Tom Thumb	" 5	42	June 22	59	12	" 6	73	July 10	77	448	462
Cleveland's Rural New Yorker	" 3	40	" 20	57	10	" 6	73	" 11	78	420	546
Dwarf Gray Sugar	" 18	55	July 3	70	15	" 17	84	" 29	96	620	620
Dwarf Green Imperial (Fr. nain vert imperial)	" 18	55	" 3	70	27	" 20	87	Aug. 6	104	672	375
Dwarf White Sugar	" 15	52	June 30	67	14	" 15	82	July 29	96	952	564
Earliest of all	" 2	39	" 18	55	11	" 6	73	" 9	76	272	506
Everitt's Extra Early Reliance	" 3	40	" 19	56	22	" 6	73	" 20	87	452	450
Extra Early Dwarf Brittany (Fr. sans párchemin nain hâtif de Brethon)	" 18	55	July 3	70	18	" 21	88	" 30	97	788	547
Extra Early Dwarf Tom Thumb	" 5	42	June 19	56	12	" 5	73	" 10	79	308	504
Forty Fold (Everitt)	" 18	55	July 3	70	27	" 21	88	Aug. 1	99	716	452
Forty Fold (Land)	" 18	55	" 3	70	20	" 23	90	" 1	99	1,008	522
Green Auvergne	" 18	55	" 3	70	27	" 20	89	" 6	105	1,188	421
Hair's Dwarf Green Marrow	" 20	57	" 6	73	9	" 22	91	" 1	99	1,168	362
Horsford's Imperial Champion	" 20	57	" 6	73	15	" 20	89	" 1	99	1,428	414
Horsford's Market Garden	" 15	52	" 30	97	18	" 18	87	" 1	99	1,156	468
Improved Prince of Wales	" 9	46	" 30	97	17	" 17	86	July 30	97	1,012	351
Irish or Large White Marrowfat	" 20	57	" 8	75	9	" 21	90	Aug. 6	105	764	471
Knight's Dwarf Green Marrow (Fr. ridé nain vert hâtif)	" 18	55	" 6	73	12	" 24	93	" 1	99	1,200	371
Landreth's Extra Early.	" 3	40	" 20	87	10	" 6	73	" 11	109	444	434
Large White Edible Pod (Fr. sans parchemin corne de belier)	" 16	53	" 6	73	14	" 17	86	" 10	108	548	545
Laxton's Supreme	" 18	55	" 6	73	15	" 21	90	" 1	99	784	497
Maud S	" 4	41	June 19	56	11	" 6	73	" 11	109	392	470
McLean's Premier	" 26	63	July 9	76	23	" 26	95	" 6	105	1,420	396
Peruvian Black Eyed Marrow	" 26	63	" 8	75	15	" 23	90	" 8	106	718	494
Philadelphia Ex. Early	" 4	41	June 22	59	8	" 6	73	July 10	77	404	452
Prince of Wales	" 16	53	July 3	70	14	" 18	85	Aug. 1	99	1,088	377
Sibley's First and Best	" 3	40	June 19	56	17	" 6	73	July 10	77	316	437
Smith's Extra Early	" 10	47	" 26	63	15	" 13	80	" 21	88	740	560
Tall White Six Weeks (Edible Pod) (Fr. sans parchemin de 40 jours)	" 4	41	" 22	59	19	" 6	73	" 16	83	516	453
Very Dwarf Bretagne	" 18	55	July 6	73	9	" 18	85	" 30	97	588	495
Vicks' Extra Early	" 3	40	June 18	55	13	" 3	70	" 9	76	308	410
Yellow Wrinkled	" 22	31	July 9	48	11	" 25	64	Aug. 8	78	420	477
Yorkshire Hero	" 16	53	" 6	73	12	" 22	89	" 1	99	872	360

The "days fit for table use" in the table indicates the days between the time when the earliest and latest pods were of edible size.

It appears that the Earliest of All, Thor., '83, and Vick's Extra Early, Vick, '85, were earliest, each furnishing pods of edible size on June 18, or fifty-five days from planting. The latter is very possibly a synonym of or a selection from the Early Kent.

The Maud S., Greg., '85, appeared to be the Philadelphia, and Everitt's Extra Early Reliance appeared to be the Daniel O'Rourke.

Cleveland's Improved Tom Thumb, Thor., '85, was evidently the old Tom Thumb, but the uniformity of the plants indicated careful breeding, and they were more prolific, but a few days later, than the Extra Early Dwarf Tom Thumb, Thor., '85.

The Dwarf Green Imperial (*Fr. nain vert Impèrial*), Vil., '85, was identical with the Blue Imperial, Thor., '82.

The plants of some of the other names bore a very close resemblance, but we will not pronounce upon them until growing them another season.

Cross Bred Peas.

We noted in our last report that one of our cross bred peas, from the American Wonder, fertilized with Earliest of All, proved to be a wrinkled pea, and as early as the earliest smooth pea on trial. We grew this selection the past year with equally favorable results; the first pods being of edible size June 18. A few seeds of the yield were smooth, but the great majority were distinctly wrinkled.

We noted also in our last report that one plant from a cross of Bliss "A No. 2," fertilized with Laxton's Marvel, yielded ninety pods. As an experiment, we planted all the seeds of this plant, not injured by the weevil, placing them eight inches apart in the row. The culture given was not equal to that given to the varieties noted in the table, but one plant bore 153 pods, fifteen plants yielded more than 100 pods, and twenty-one more than ninety pods, all wrinkled peas. These very prolific plants were so tall as to make them of doubtful value as garden peas. We shall however plant the seeds from one or two of the most prolific ones, simply to see how large a yield we can secure by selection.

Mulching as a Preventive of Mildew.

We found on experiment that mulching the soil lightly between the rows with straw retarded the attack of mildew very perceptibly. The date when the mulched rows became overrun with this parasite was not noted, but on Aug. 12 they were free from mildew, while unmulched rows planted at the same time were entirely enveloped.

Pinching the Terminal Shoots to Promote Earliness.

We pinched the terminal shoots of alternate rows of a planting of eight rows of peas made April 30, in order to note the effect upon the earliness of the pods. The first pods on the pinched rows were of edible size about July 21, and on the unpinched rows July 24, indicating a very slight influence from the pinching in favor of earliness.

Planting Sprouted Seed to Secure Earliness.

We noted in 1884, that permitting the seed of peas to sprout before planting indicated an advantage in the earliness of the first pods of about eight days. The past season we repeated this experiment. A quantity of Philadelphia peas were placed to sprout in moist sand on March 28. April 16, one row of the sprouted seed was planted, and adjoining one row of unsprouted seed taken from the same package as was the sprouted seed.

The sprouted seed commenced vegetating April 23, and the unsprouted seed April 25. The plants from the sprouted seed bloomed May 25, and those from the unsprouted seed May 28, three days later. The earliest pods from the sprouted seed were of edible size June 13, and from the unsprouted June 17th, indicating a gain in this case of four days.

Seeds Planted in Order from the Pods.

In our last report we gave the result of an experiment in planting the seeds of Culverwell's Telegraph pea in order from the pod; that is, we selected fifty pods containing eight seed each, and planted the seeds next the stem in all the pods in the first row, the second seeds from the stem in the second row, and so on to the last. We were unable to interpret the results, but have repeated the experiment in part the past season, taking the seeds from the yield of the experiment noted last year. Again the results are confusing and contradictory. It appears as if the position of the seeds in the pod has little if any influence upon the resultant plants.

SPINACH.

Seeds of the following list of Spinaches were planted in the garden April 25, in rows 21 inches apart and 12 feet long. The soil was prepared as noted for the beet, and was in excellent condition.

We noted the following data :

Spinach.	Of edible size.	Days from planting.	Dys. fit for table use.	First bloom.	Days from planting.	First seed ripe.	Days from planting.
Bloomsdale	May 31	36	5	June 5	41	June 18	54
Bloomsdale Savoy	" 31	36	5	" 5	41	" 18	54
Henderson's Norfolk Savoy-Leaved	" 31	36	5	" 5	41	" 18	54
Long Standing	" 31	36	18	" 18	54	July 11	77
Thick-Leaved (Hen.)	" 31	36	17	" 17	53	" 11	77
Thick-Leaved (Howcroft)	" 31	36	17	" 17	53	" 11	77

The "days fit for table use," indicates the number of days between the time when the leaves were of fair edible size and when the flower stalks appeared.

Synonyms.

We were able to detect no difference between the Bloomsdale, Land.,'85 ; the Bloomsdale Savoy, Howcroft, '85, and Henderson's Norfolk Savoy-Leaved, Hen., '85.

Additional Notes.

It appears that the Long Standing and Thick Leaved were decidedly later in blooming than the others.

The results of some plantings made in the fall of 1884, of seed from the plants that mature earliest and from those that mature latest, indicate that the seed from the early maturing plants germinates better, and produces more vigorous growth, than that from the later plants, but that the plants from it probably bloom earlier.

OKRA.

We planted seeds of eleven differently named samples of okra, in boxes in the greenhouse April 7, and transplanted eight plants of each name to the garden June 8, setting them in rows twenty-one inches apart and eighteen inches apart in the row.

As the plants developed, it appeared that the varieties were very much mixed in many rows. Indeed we were able to make out but three clearly distinct varieties from the whole number, viz : a tall and a dwarf variety, and the Louisiana Gumbo. The names and data noted are as follows:

Okra. or Gumbo.	First bloom.	Days from planting.	Of edible size.	Days from planting.
Dwarf (Land.)	July 13	97	July 30	114
Dwarf (Thor.)	“ 18	102	“ 30	114
Dwarf Prolific	“ 8	93	“ 27	111
Dwarf White	“ 27	111	Aug. 6	121
Improved Dwarf Green	“ 22	106	July 30	114
Long Green	“ 25	109	Aug. 3	118
Louisiana Gumbo	“ 20	104	July 30	114
New Early Improved Dwarf	Aug. 3	118	Aug. 17	132
Prolific	July 25	109	“ 4	119
Tall (Land.)	“ 15	99	July 30	114
Tall (Sib.)	Aug. 4	119	Aug. 10	125
Tall Green	July 30	114	“ 17	132
White Pod	“ 31	115	“ 5	120

The Louisiana Gumbo, Thor., '85, appeared to be the same as the Dwarf White, of same source.

The Tall, Land.,'85, seemed the same as the Dwarf Prolific, Hen., 1885.

The Dwarf, Thor., '85, seemed the same as the Long Green, of same source.

The Dwarf, Land., '85, appeared the same as the Tall, Sib., '85.

Our notes were purposely postponed until late (Sept. 1), in order to give all the plants opportunity to develop. As will appear they were taken nearly a mouth after the majority of the plants had formed pods of edible size.

BEANS.

We have devoted little attention to this vegetable as compared with the very thorough work accomplished in 1882 and 1883 by Mr. Wing. We however made a few plantings the past season, of which the data noted are given below. The seeds were planted May 28 in rows twelve feet long and three and a half feet apart, one row to each variety. Six of the varieties failed to ripen all their pods.

Beans.	First bloom.	Days from planting.	Of edible size.	Days from planting.	First seed ripe.	Days from planting.	Last seed ripe.	Days from planting.	Number of pods per 100 plants.	Number of beans per 100 pods.
Dwarf Mont D'Or	July 8	41	July 21	54	Aug. 21	85	Sept. 27	122	1007	194
Extra Early Arostook	" 9	37	" 24	50	" 14	71			?	390
Improved Flageolet	" 6	39	" 25	58	" 14	78	Aug. 27	91	?	312
Imperial Prolific Tree	" 3	63	Aug. 12	76	Sept. 21	116			4600	400
Improved Navy	" 8	41	" 25	58	Aug. 19	83			954	435
Improved Yellow Eye	" 8	41	" 22	55	" 21	85	Sept. 15	110	909	392
Long Black Belgian	" 8	41	" 24	57	" 15	79			416	400
Long Black Canterbury	" 10	43	" 22	55	" 26	90	" 21	116	596	332
Maine Frost Proof	" 6	34	" 20	48	" 11	68			?	378
Pea Bean 1000 to 1	" 15	48	" 27	60	Sept. 15	110			3682	517
Sir Joseph Paxton,	" 8	41	" 22	55	Aug. 10	74	Sept. 15	110	700	168

Brush vs. Poles for Lima Beans.

We made the experiment of bushing Lima beans with tall pea brush, pinching the tips of the runners as fast as they reached the top of the brush, in order to see if this would not hasten the development of the pods.

On June 1 we planted eight short rows of the Small White Lima bean, for this experiment. Four of the rows were bushed, and the remaining four were poled with tall poles. We noted no difference in the time of blooming, in the date of edible size, in the time of ripeness, nor in the productiveness of the rows treated in the two ways. The runners appeared to find their support more readily on the bushed than on the poled rows, and we saw no reason in this experiment why the brush may not be used as a substitute for poles.

PARSLEY.

We planted seeds, purporting to be of nine varieties of parsley, in boxes in the cold frame Apr. 7, transplanting eleven plants of each to the garden June 8th.

As the plants developed, the varieties appeared much mixed.

The New Perpetual, Greg.,'85 and Moss Curled, Sib.,'85 appeared identical; also Henderson's Emerald, Hen., '85, and Double Curled, Sib., '85.

Of the Champion Curled, Thor., '85, about half of the plants appeared the same as the Fern-Leaved, from the same source, and the other half were apparently identical with Carter's Fern-Leaved, Sib., '85. The latter was scarcely if at all distinct from that of Moss Curled, Sib.; '85.

MISCELLANEOUS VEGETABLES, ETC.

Besides the vegetables already considered we grew several varieties, or names of varieties each of corn salad, cress, endive, mustard, pumpkin and purslane, with thirty-six varieties or species of the class of plants known to seedsmen as "herbs." We present the data gathered upon these plants in tabular form, for purposes of reference. We have given less attention to these plants than to the more generally grown vegetables.

Corn Salad.	First bloom.	Days from planting.	First seeds ripe.	Days from planting.
Corn Salad or Fetticus	--------	----	--------	----
English Green Cabbaging (Fr. verte à coeur pleine)	July 30	96	--------	----
Green Etampes (Fr. verte d'Etampes)	" 23	89	--------	----
Italian (Fr. d'Italie)	" 15	81	Aug. 7	104
Italian or Lettuce-Leaved (Fr. d'Italie à feuille de laitue)	" 21	87	Aug. 10	107
Large Round Leaved (Fr. à feuille ronde)	" 15	81	--------	----
Large Seeded Dutch (Fr. à feuille ronde à grosse graine)	" 29	95	--------	----

The first in the list, Corn Salad, or Fetticus, Thor., '85 proved to be the Large Seeded Dutch (*Fr. Mache à feuille ronde à grosse graine*, Vil., '85. The others appeared distinct.

Cress.	First bloom.	Days from planting.	First seeds ripe.	Days from planting.
Broad Leaved Garden (Fr. Alenois à large feuille)	July 10	76	Aug. 8	105
Common or Plain (Fr Alenois commun)	June 20	56	July 22	88
Curled Garden (Fr. Alenois frisé)	July 6	72	July 28	94
Dwarf Extra Curled (Fr. Alenois nain très frisé)	June 22	58	July 23	89

We have very little success growing the cress from spring plantings, owing to attacks of the flea-beetle. Planted about August 1, however, the plants make a vigorous growth, especially if the bed is mulched lightly, and watered each evening, if the weather is dry, until they secure a start.

ENDIVE.	First edible size.	Days from planting.	Flower-stalk appeared.	Days from planting.	First bloom.	Days from planting.	First seed ripe.	Days from planting.
Broad Leaved or Batavian (Fr. Scarole ronde)	June 11	47	July 6	72	July 23	89	Oct. 10	168
Broad Leaved Large Limay (Fr. Scarole grosse de Limay)	" 11	47	" 9	75	" 25	91	" 12	170
Broad Leaved White or Lettuce Leaved (Fr. Scarole blonde)	" 11	47	" 6	72	" 21	87	" 9	167
Broad Leaved Winter (Fr. Scarole en cornet)	" 11	47	" 9	75	" 21	87	Sept. 15	143
Curled Ruff (Fr. frisée de Ruffec	" 16	52	" 8	74	" 23	89	Oct. 9	167
Curled Winter (Fr. frisée d'hiver)	" 11	47	" 6	72	" 21	87	Sept. 15	143
Green's fine Curled Louviers (Fr. frisée fine de Louviers)	" 17	53	" 6	72	" 18	84	" 15	143
Green Fine Curled Picpus (Fr. frisée de Picpus)	" 18	54	" 10	76	" 27	93	" 15	143
Green Fine Curled Summer (Fr. frisée fine d'été race d'Anjou)	" 17	53	" 6	72	" 24	90	" 15	143
Green Fine Curled Winter (Fr. frisée de Meaux)	" 18	54	" 11	77	" 28	94	" 15	143
Green Very Fine Parisian Summer (Fr. frisée fine d'été race Parisienne)	" 17	53	" 6	72	" 23	89	" 15	143
Imperial Curled (Fr. frisée Impèriale)	" 18	54	" 9	75	" 25	91	" 15	143
Large Curled Pancaliere (Fr. frisée grosse Pancaliere)	" 17	53	" 6	72	" 25	91	" 15	143
Moss Curled	" 16	52	" 6	72	" 18	84	" 15	143
Very Fine Curled Moss (Fr. frisée mousse)	" 18	54	" 9	75	" 25	91	" 9	137
White Curled	" 17	53	" 6	72	" 23	89	" 9	137

All of the above appeared distinct except the last one, White Curled, Thor., '85, which was apparently the same as the Ever White Curled. (Fr. *Chicorée toujours blanche*), Vil., '84.

MUSTARD.	First bloom.	Days from planting.	First seed ripe.	Days from planting.
Brown	June 8	44	July 20	86
Chinese Cabbage Leaved (Fr. de Chine à feuille de Chine)	" 13	49	" 25	91
Chinese White	" 8	44	" 20	86
Tuberous Rooted (Fr. de Chine tubereuse)	" 15	51	" 31	97
White	" 8	44	" 20	86

The so-called Tuberous Rooted Mustard (Fr. *Moutarde de Chine tubereuse*), Vil.,'85, is interesting as a new introduction. The roots, which form the part most used, are thick and fleshy, resembling in form, color, and taste those of the half long white radishes.

PURSLANE.	First bloom.	Days from planting.	First seeds ripe.	Days from planting.
Golden (Fr. doré)	July 6	72	Aug. 10	97
Golden, Extra Large (Fr. doré à large feuille)	" 6	72	" 8	95
Green (Fr. vert)	" 6	72	" 11	98

These are garden varieties of the common purslane, *Portulacca oleracea* L., and are grown in France as vegetables, the foliage being eaten both raw and cooked. The varieties appeared quite distinct, and all were more vigorous and succulent than the common purslane.

PUMPKIN.	First bloom.	Days from planting.	First fruit ripe.	Days from planting.
Cashaw (Land.)	July 25	57	Oct. 1	125
Cushaw (Sib.)	" 27	59	" 1	125
Golden Marrow	" 17	49	Sept. 25	119
Grey Boulogne	" 24	56	----	----
Michigan Mammoth	" 15	47	Sept. 21	115
Negro or Nantucket	" 20	52	----	----
Nigger	" 20	52	----	----
Tree	" 20	52	----	----

We have noted the date of ripeness only in those varieties in which this stage was clearly marked.

The Michigan Mammoth, Greg.,'85, bore a close resemblance to the Golden Marrow, Till.,'85. The Negro or Nantucket, Greg., '85, was entirely distinct from the Nigger, Sib., '85.

HERBS.	First bloom.	Days from planting.	First seeds ripe.	Days from planting.
Balm (planted 1883)	----	----	----	----
Basil—Anise Scented	July 31	97	----	----
Basil—Bush Green (Fr. fin vert)	Aug. 12	109	----	----
Basil—Bush Purple (Fr. fin violet)	" 1	98	----	----
Basil—Curled (Fr. frisé)	----	----	----	----
Basil—Large Purple (Fr. grand violet)	July 30	96	----	----
Basil—Lettuce-Leaved (Fr. feuille de laitue)	" 27	93	----	----
Borage	June 26	62	Aug. 8	----
Burnet (planted 1884)	May 28	----	July 28	----
Caraway (planted 1884)	June 1	----	" 31	----
Catnip	July 3	----	Aug. 8	----
Chervil—common (Fr. Cerfeuil commun)	June 29	65	July 30	96
Chervil—curled (Fr. Cerfeuil frisé)	" 20	56	" 27	93
Chervil	" 26	62	" 28	94
Coriander	Aug. 10	----	Sept. 15	----
Dill	July 6	75	Aug. 1	101
Fennel—bitter (Planted 1884)	June 30	----	" 7	----
Fenugreek	" 19	55	" 18	115
Gobo (planted 1883)	July 25	----	Sept. 15	----
Horehound (planted 1884)	" 17	----	" 8	----
Horse-Radish	----	----	----	----
Hyssop (planted 1884)	July 29	----	July 30	----
Marjoram—Common (Fr. Marjolaine ordinaire)	Aug. 12	109	----	----
Marjoram—Pot (Fr. Marjolaine vivace)	" 11	108	----	----
Nigella Aromatique	June 20	66	Aug. 10	107
Peppermint	----	----	----	----
Rue (planted 1884)	June 13	----	Aug. 12	----
Saffron—false	July 20	86	" 14	114
Sage—common garden (planted 1883)	June 14	----	July 30	----
Sage—Salvia argentea (planted 1883)	" 13	----	" 24	----
Sage—Salvia horminum purpureum (planted 1883)	June 20	----	July 24	----
Sage—Salvia horminum violette (planted '83)	" 8	----	" 24	----
Sorrel (planted 1884)	" 6	----	Aug. 5	----
Summer Savory	Aug. 11	108	----	----
Thyme (planted 1884)	June 8	----	----	----
Thyme French (planted 1884)	" 1	----	July 30	----
Valerian d'Alger (Fr.)	" 24	60	----	----

We also grew five differently named Collards, and seven kales.

Judging from the samples grown, the name Collards is a very indefinite term. One sample of seed, labeled Georgia collards, Howcroft, '85, produced plants three to four feet high that closely resembled the kale Branchu du Poitou, Vil., '83. Another called Improved Marrowfat, Howcroft, '85, grew to an equal height and was apparently the same as the Marrow-stemmed White kale, Ben., '83. A third sample called True Georgia, Sib.,'85, grew about two feet high, with the semblance of a head at the top of the stem. A sample called True Rosette Collard, or Colewort, Greg.,'85, grew but fifteen inches high, and formed a beautiful rosette of spoon formed leaves, which in a few of the plants embraced each other rather closely, forming a loose head. A sample called Southern, Land.,'85, was too much mixed for description, scarcely two plants being alike. One plant formed a firm head, and was unquestionably a cabbage.

The kales grown were apparently true to name, and distinct.

BASELLA OR WHITE MALABAR NIGHTSHADE (*Basella alba L*).

We grew this plant the past season for the first time. It has twining stems and very thick, tender, fleshy leaves, and is grown in France to some extent as a substitute for Spinach. The foliage possesses so much succulency that a stem of it hung up in a dry room remained fresh and green for a fortnight.

CHOU DE BURGHLEY.

Seeds of this so-called new vegetable were sent us by Messrs. Vilmorin, Andrieux et Cie. It belongs to the cabbage family, and might be called a combination of Brussels sprouts and cabbage. It formed a large loose head at the top of the stem, and several smaller ones at the axils of the leaves. The latter were three to four inches in diameter, but were not very solid.

GOURDS.

We also grew thirty varieties and species of Cucurbiteae, other than the pumpkins, melons, squashes and cucumbers already noted. As many of these failed to ripen, and as they have little value except for ornament and as curiosities, we do not present them in tabular form.

POTATOES.

A Test of Varieties.

We have continued our test of varieties of the potato the past season by planting the greater part of those previously grown, with 64 sorts not before tested at the station; our whole list comprising 187 varieties, or names of varieties. The test was made in two separate plantings. One planting of 116 varieties, including the sixty-four not previously tested was made in the station garden May 1st.* The tubers were cut to single eyes and the cuttings placed a foot apart in shallow drills, twelve feet long and three and a half feet apart, and two drills were planted with each name. Thus there were twenty-two hills of each name, with a few exceptions.

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*Four exceptions in the date of planting are noted in the table.

In forty-five of the varieties, the cuttings planted in the first row were taken from a very large tuber, and those planted in the second row, from one or more tubers just large enough to be merchantable. As will appear, we give the yields of these tubers separately.

The soil was heavily manured in November, 1884, with well rotted barn-yard manure, which was plowed in as soon as applied. As we did not desire to raise the manure to the surface in the spring, we did not plow the ground before planting, but simply cultivated the surface.

No weeds were permitted to grow among the plants, and when these were about half grown, the hills were ridged to a moderate height. After the tops were dead, the crop was harvested.

In the following table, the yields are given, calculated on the basis of one hundred hills. That is to say, the large tuber of the Adirondack, of which eleven eyes were planted, would have yielded 205 pounds of tubers, had there been 100 eyes, yielding at the rate that the eleven eyes yielded. We adopt this method of expressing yields for several reasons. One or more of the eyes planted often fails to vegetate. Sometimes a single tuber is sent in for trial, of which there are not eyes enough for a whole row. In order to make all comparable, therefore, we must reduce them to one standard. It is very desirable, also, to be able to compare the yields as given in the reports of different years, which would be difficult were they not all calculated on the basis of a given number of hills. We have, therefore, followed this method in all of our reports of the yields of different varieties of the potato.

As will appear from the table, potatoes rotted badly at the station the past season, some varieties being a total loss. We give, *by number*, the per cent. of tubers more or less decayed of each variety, calculated at the time of digging on the entire yield; that is, on both the merchantable and unmerchantable tubers.

Tubers of merchantable size that grew much mis-shapen are designated " malformed," and the number of such is also expressed in per cent.

POTATO—A TEST OF VARIETIES.—FIRST PLANTING.

	Date of first vegetation.	No. of eyes that vegetated.	Date of first bloom.	Date when tops were dead.	Calculated on basis of 100 hills. No. merchantable tubers.	Weight of merchantable tubers.		Total number of tubers.	Total weight of tubers.		Per cent. of rotten tubers.	Per ct. of malformed tubers
						lbs.	oz.		lbs.	oz.		
Adirondack—large tuber	May 29	11	July 6	Sept. 19	370	136	14	930	205	0	51	
“ small “	“ 25	11	“ 3	“ 19	191	96	8	846	169	14	33	
American Giant—large tuber	“ 26	11	“ 8	“ 15	330	141	4	720	181	4	83	7
“ “ small “	“ 25	11	“ 9	“ 15	373	170	7	718	210	10	91	11
Beauty of Hebron	“ 21	22	June 30	Aug. 27	248	71	0	533	96	7	33	1
Belle—large tuber	“ 28	11	July 10	Sept. 15	190	109	6	290	123	2	66	
“ small “	“ 28	11	“ 10	“ 15	245	122	3	336	131	13	97	5
Bliss Triumph—large tuber	“ 25	11		Aug. 18	180	43	12	630	75	0	38	
“ “ small “	“ 25	10		“ 18	40	8	2	380	36	4	16	
Blood Heart	“ 23	22	July 13	Sept. 6	352	143	0	1114	178	7	92	1
Bodega Red	“ 23	22	“ 13	“ 17	0	0	0	176	15	8	90	
Bonanza	“ 22	22	“ 10	“ 18	343	107	14	843	155	13	79	
Boston Cracker	“ 22	22	June 30	Aug. 22	110	28	0	620	66	7	34	
Boston Market—large tuber	“ 23	11	“ 26	“ 25	180	54	6	500	90	10	0	
“ “ small “	“ 25	11	“ 26	“ 25	273	71	0	491	85	8	65	
Brownell's Best—large tuber	“ 25	11		Sept. 18	340	104	1	930	159	9	76	
“ “ small “	“ 25	11		“ 17	355	108	13	719	143	3	85	
†Burbank's Seedling	“ 30	21	July 10	“ 19	530	165	3	1230	205	2	10	
Burpee's Empire State	“ 22	22	June 26	“ 18	457	182	12	1029	224	9	86	7
Burrough's Garfield	“ 20	22	“ 24	“ 14	400	128	7	738	156	4	92	5
Chicago Beauty	“ 22	22		“ 10	348	154	8	605	177	9	92	1
Chicago Market—large tuber	“ 25	11	June 20	“ 5	310	126	4	650	154	6	91	8
“ “ small “	“ 25	11	“ 27	“ 9	291	118	3	509	136	6	84	7
Clark's No. 1—large tuber	“ 25	11	“ 30	“ 15	330	98	2	710	128	7	85	10
“ “ 1 “ “	“ 25	11	“ 30	“ 15	391	182	6	700	221	5	92	13
Colvin's Early White Prize—large tuber	“ 23	11	“ 26	Aug. 27	310	89	1	800	130	0	37	
Colvin's Early White Prize—small tuber	“ 25	11	“ 26	“ 27	336	98	9	727	132	11	17	
Colvin's Excelsior	“ 23	22	July 3	Sept. 15	329	121	4	543	135	4	58	8
Conqueror—large tuber	“ 27	10		“ 14	356	129	14	756	163	3	91	3
“ small “	“ 27	8		“ 14	312	124	4	450	132	7	100	
Corless Matchless—l'ge tuber	“ 27	11	June 30	“ 14	410	192	8	680	224	1	96	3
“ “ sm'l “	“ 25	11	“ 30	“ 14	373	155	11	682	194	5	88	7
Cow-Horn	“ 25	22	July 8	“ 3	229	83	12	638	142	8	42	2
Crandall's Beauty	“ 25	22	“ 1	Aug. 24	300	93	2	724	121	8	33	
Crane's Potentate	“ 25	21	“ 1	“ 27	305	93	4	850	130	5	31	1
Crawford's Seedling	“ 25	22	June 26	“ 25	229	65	11	833	101	13	19	
§Cream of the Field	“ 25	22	“ 26	Sept. 19	395	149	9	705	178	3	84	12
Dakota Red—large tuber	June 1	11		“ 25	320	175	0	490	207	8	37	16
“ “ small “	May 27	11	July 10	“ 25	300	167	1	482	186	6	62	26
Defiance—large tuber	“ 28	11		“ 18	360	101	4	1180	170	0	55	
“ small “	“ 27	11		“ 18	645	219	3	1482	279	6	63	
Diamond	“ 25	22		Aug. 24	138	37	10	533	77	13	36	
Dictator	“ 26	22		Sept. 18	448	188	9	910	252	8	94	2
Dunmore—large tuber	“ 28	11		“ 15	290	158	2	800	193	2	97	6
“ small “	“ 27	11		“ 18	273	134	1	627	162	8	100	4
Early Essex	“ 22	22	June 30	Aug. 24	314	96	12	682	123	9	17	
Early Electric—large tuber	“ 29	11		“ 24	220	73	2	540	90	0	52	
“ “ small “	“ 28	11		“ 24	164	46	5	328	60	4	39	
Early Illinois	“ 25	22		“ 24	195	64	12	438	88	4	40	
Early Maine—large tuber	“ 25	11	June 27	“ 24	490	163	12	1060	205	0	17	
“ “ small “	“ 25	11	“ 30	“ 25	482	173	2	1073	215	12	34	3
Early Mayflower—l'ge tuber	“ 25	11		“ 29	480	134	11	1430	203	12	30	
“ “ sm'l “	“ 27	11		“ 29	373	119	0	1010	165	1	42	
Early Mohawk	“ 23	22		Sept. 15	452	181	2	657	198	8	80	9
Early Ohio	“ 26	22		Aug. 24	218	69	14	436	84	11	46	
Early Pearl	“ 24	22	June 26	“ 24	262	87	8	676	114	14	18	
Early Perfection	“ 23	22	“ 27	“ 25	210	50	0	570	79	6	18	7
Early Rose—large tuber	“ 25	11	“ 26	“ 22	220	64	6	630	99	6	35	
“ “ small “	“ 25	11	“ 30	“ 21	200	60	13	518	88	1	50	5
Early Snowflake—l'ge tuber	“ 27	11		“ 27	300	92	8	960	142	8	52	
“ “ sm'l “	“ 25	11		“ 26	273	96	14	691	126	11	28	
Early Sunrise—large tuber	“ 25	11	June 27	“ 25	360	138	12	1010	192	8	65	1
“ “ small “	“ 26	11	“ 30	“ 27	382	137	12	682	163	15	44	
Early Telephone—l'ge tuber	“ 28	11		Sept. 3	400	131	4	1070	160	0	79	
“ “ sm'l “	“ 27	11		Aug. 27	364	109	15	791	173	8	38	
Early Vermont—large tuber	“ 25	11	July 3	Sept. 3	430	194	1	780	222	3	87	8
“ “ small “	“ 26	11	“ 3	“ 3	373	171	5	618	191	12	87	9
Garretson's No. 8—l'ge tuber	“ 26	11	“ 7	“ 15	420	133	7	920	165	5	41	2
“ “ 8 sm'l “	“ 25	22	“ 7	“ 15	473	153	2	745	179	13	44	

† Planted May 4.

§ Planted May 18.

	Date of first vegetation	No. of eyes that vegetated.	Date of first bloom.	Date when tops were dead.	Calculated on basis of 100 hills.							
					No. merchantable tubers.	**Weight of merchantable tubers.**		Total number of tubers.	**Total weight of tubers.**		Per cent. of rotten tubers.	Per ct. of malformed tubers
						lbs.	oz.		lbs.	oz.		
Genesee	May 23	22	July 1	Sept. 3	314	112	8	571	133	6	58	
Great Eastern	“ 23	22		“ 19	319	163	1	705	199	6	97	
Hall's Early Peachblow	“ 27	22	July 6	“ 20	243	97	10	438	121	11	50	8
Harmony	“ 25	22	June 30	“ 26	352	116	1	695	145	9	65	1
Improved Pinkeye	“ 25	22	July 6	“ 25	281	109	8	552	133	1	58	13
Irish Wonder	“ 26	22		“ 15	362	163	4	671	188	4	79	6
Jones' Prizetaker—l'ge tuber	“ 25	11	June 30	“ 5	450	188	12	780	223	7	90	5
“ “ sm'l “	“ 27	11	July 7	“ 3	191	53	7	673	91	8	95	1
Jordan's Russet	“ 25	22	“ 1	“ 3	286	112	8	457	121	12	54	2
Jumbo—large tuber	“ 25	11	“ 1	Aug. 27	270	75	0	710	110	0	27	
“ small “	“ 25	11	“ 1	Sept. 15	236	78	7	455	106	13	50	
Kennedy	“ 28	22	“ 10	Aug. 25	84	18	12	405	42	14	26	1
Late Beauty of Hebron—large tuber	“ 25	11	“ 6	Sept. 3	220	60	2	510	89	7	63	2
Late Beauty of Hebron—small tuber	“ 27	11	“ 7	“ 18	345	109	15	709	135	8	37	3
Lee's Favorite—large tuber	“ 23	11	June 30	Aug. 24	200	63	12	780	102	8	80	8
“ “ small “	“ 25	11	July 1	“ 24	391	129	8	718	158	13	33	2
Magnum Bonum—l'ge tuber	“ 27	11	“ 13	Sept. 3	300	112	8	490	127	8	22	
“ “ sm'l “	“ 25	11	“ 8	“ 15	273	106	0	309	108	8	62	
Mammoth Pearl	“ 28	19		“ 15	339	133	5	711	159	6	99	5
Manitoba	“ 27	22		“ 5	367	90	4	781	122	11	85	
McFaden's Seedling	“ 26	22		Aug. 27	257	79	12	376	90	0	23	
Napaug—large tuber	“ 27	11	July 10	Sept. 24	290	142	8	460	163	2	93	15
“ small “	“ 25	11	“ 13	“ 24	309	145	7	445	160	14	90	
New York State	“ 25	21	June 30	“ 19	395	151	8	681	180	8	88	8
Nott's Victor—large tuber	“ 26	11	July 1	Aug. 25	360	116	14	600	148	2	23	
“ “ small “	“ 26	11	June 30	“ 27	373	121	10	664	146	10	37	
Ogden's Beauty	“ 28	18		Sept. 15	341	112	5	647	137	11	65	
O. K. Mammoth—l'ge tuber	“ 28	11		“ 19	410	205	0	700	228	7	97	3
“ “ sm'l “	“ 29	11		“ 19	318	147	3	1009	202	4	92	3
Ontario's Jumbo	“ 26	22		“ 15	305	143	2	648	175	0	91	5
Parson's Prolific	“ 27	21		“ 17	345	138	4	730	169	8	93	1
Pearl of Savoy	“ 23	22	June 27	Aug. 25	200	59	4	676	94	1	14	
Peck	“ 25	22	July 6	Sept. 15	290	109	6	533	142	1	66	1
Perfection	“ 25	22	“ 1	“ 4	400	123	2	995	197	7	45	
Prairie Farmer	“ 25	22		“ 15	343	135	0	662	163	6	90	5
Pride of America	“ 25	22		Aug. 29	214	66	1	833	117	5	30	
Pride of Lisbon	“ 23	22	June 30	Sept. 15	305	122	3	595	147	10	81	6
Pride of the West	“ 23	22		“ 15	290	89	9	657	115	12	92	1
Queen of the Valley	“ 26	22	June 30	“ 5	224	63	9	652	97	1	80	
Red Star	“ 26	22	“ 30	“ 19	252	124	14	409	140	12	95	2
Rochester Favorite—large tuber	“ 27	22		“ 19	370	140	2	710	175	10	79	7
Rochester Favorlte—small tuber	“ 28	22		“ 19	391	159	2	618	186	6	75	4
Rose's Beauty of Beauties	“ 25	22		“ 15	348	161	15	738	194	10	95	4
Rose's New Giant	“ 25	22	July 3	“ 15	419	191	1	686	213	9	96	5
Rose's President Cleveland	“ 23	22		“ 17	262	71	7	486	88	11	100	5
Rose's No. 76	“ 25	21	July 10	“ 25	345	126	13	770	172	8	57	
Rose's Purple Blush	“ 26	22		“ 19	429	138	2	867	177	8	81	1
Rosy Morn—large tuber	“ 26	10	June 27	Aug. 25	367	106	15	877	145	2	25	
“ “ small “	“ 25	11	“ 27	“ 25	282	92	1	691	122	12	31	
Rubicund—large tuber	--------	11		Sept. 19	190	53	12	400	73	2	90	
“ small “	May 30	11		“ 19	164	45	7	400	62	12	93	
Rural Blush—large tuber	June 3	10	July 15	“ 24	390	171	4	750	219	6	83	4
“ “ small “	May 30	9	“ 15	“ 24	275	129	11	525	156	10	36	
St. Patrick—large tuber	“ 27	11	“ 7	“ 17	300	122	8	430	143	12	..	19
“ “ small “	“ 28	11	“ 7	“ 17	318	148	5	473	164	3	87	6
Salt Lake Queen	“ 25	22	“ 7	“ 15	429	139	5	752	162	1	82	2
Schoolmaster—large tuber	“ 26	11	“ 8	“ 15	350	170	0	590	192	8	100	3
“ small “	“ 27	11	“ 7	“ 15	409	170	7	627	192	1	76	6
Seneca Red Jacket	“ 26	22	“ 3	“ 15	352	130	1	490	143	12	93	
Sunlit Star	“ 23	22	June 30	Aug. 25	181	58	1	881	109	4	18	
Spaulding's Seedling	“ 23	22		Sept. 5	343	99	12	957	144	15	64	
Stanton	June 1	22	July 7	“ 19	238	103	7	314	110	2	97	5
Stray Beauty	May 26	22		Aug. 24	90	22	8	705	66	13	3	
Thorburn	“ 23	8	June 22	“ 25	257	54	7	1214	108	15	15	
Tioga—large tuber	“ 29	11	July 8	Sept. 17	350	151	4	730	179	13	95	10
“ small “	“ 27	11	“ 7	“ 19	345	136	6	755	174	11	96	11
Tunxis—large tuber	“ 26	11	“ 8	“ 15	410	168	2	670	195	10	76	
“ small “	“ 26	11	--------	“ 15	273	79	9	773	140	5	18	1

					Calculated on basis of 100 hills.							
	Date of first vegetation	No. of eyes that vegetated.	Date of first bloom.	Date when tops were dead.	No. merchantable tubers.	**Weight of merchantable tubers.**		Total number of tubers.	**Total weight of tubers.**		Per cent. of rotten tubers.	Per ct. of malformed tubers
						lbs.	oz.		lbs.	oz.		
Tyrian Purple	May 27	21	July 8	Aug. 29	250	57	15	840	99	12	3	
Vermont Champion	June 1	21	“ 10	“ 29	135	32	8	330	50	15	9	
Vanguard	May 25	22	“ 3	“ 25	214	57	14	957	114	2	14	
Vick's Extra Early—large tuber	“ 25	11		“ 17	80	19	13	1070	91	1	7	1
Vick's Extra Early—small tuber	“ 25	11		“ 17	109	23	5	900	77	13	11	
Vick's Prize—large tuber	“ 30	11		Sept. 17	360	152	13	960	195	10	99	2
“ “ small “	“ 30	11		“ 15	373	158	13	945	187	8	97	2
Wall's Orange—large tuber	“ 27	11	July 6	“ 15	500	145	0	970	190	0	68	
“ “ small “	“ 27	11	“ 6	“ 15	409	129	9	727	163	12	82	
Weld's No. 1	“ 25	22	“ 6	“ 15	329	163	11	443	175	5	99	1
White Elephant—l'ge tuber	“ 25	11	“ 6	“ 19	320	144	6	800	190	0	95	12
“ “ sm'l “	“ 28	11	“ 8	“ 19	300	109	1	827	159	11	82	12
White Lily	“ 26	22		“ 3	200	72	15	476	97	5	52	2
White Kidney	“ 26	21	“ 7	“ 3	10	2	3	838	43	14	45	
White's Seedling	“ 27	20	“ 7	“ 15	337	136	8	974	193	15	78	7
White Star —large tuber	June 1	11	“ 13	“ 17	300	143	2	540	173	12	87	17
“ “ small “	May 29	10	“ 10	“ 17	310	136	4	430	147	3	88	9
Winslow's Seedling—large tuber	“ 25	11	July 6	Sept. 5	100	45	10	840	165	10	46	
Winslow's Seedling—small tuber	“ 28	10	“ 6	“ 5	340	141	14	830	194	6	100	4
Yellow Elephant	“ 25	22	June 30	“ 15	352	134	8	852	187	3	57	
Seedling from A. Donald	“ 29	11		Aug. 25	140	55	10	430	88	2	----	9
Seedling from A. B. Lovett	“ 23	22		“ 27	210	58	10	952	107	2	----	1
‡Seedling from J.C. Robinson No. 7	June 1	12		Sept. 19	327	95	12	582	118	8	62	9
‡Potato from Southern California	“ 4	12		Aug. 29	136	34	15	391	56	4	5	

‡ 12 eyes planted May 15.

It appears that the largest merchantable yield was from the small tuber of the Defiance, the second was from the large tuber of the O. K. Mammoth, and the third was from the large tuber of the Corless Matchless. Calculating the yields of these varieties per acre, allowing every eye to have grown, and sixty pounds to the bushel, the Defiance would have yielded nearly 455 bushels of merchantable tubers; the O. K. Mammoth nearly 426 bushels, and the Corless Matchless a little over 399 bushels per acre.

The largest total yield was also from the small tuber of the Defiance—at the rate of nearly 580 bushels per acre; the second from the O. K. Mammoth, nearly 474 bushels, and the third from Burpee's Empire State, nearly 466 bushels per acre.

The smallest yield was from the Bodega Red, which yielded no merchantable tubers. This variety should hardly be compared with the others, however, as it is quite distinct in some respects, and has even been considered a distinct species. It is said that in the dry summers of California, this potato grows fully two months longer than other kinds, and produces large tubers, which are of good quality.

Throwing out the Bodega Red, the smallest merchantable yield was from the White Kidney, which produced less than five bushels per acre, and the smallest total yield was from the small tuber of Bliss' Triumph, which yielded a little more than seventy-five bushels per acre. The large tuber of the same variety, however, yielded more than double this amount.

The earliest variety, as indicated by the death of the tops, was Vick's Extra Early, of which the foliage was entirely dead August 17. Bliss' Triumph was noted ripe only one day later. The foliage of the small tuber of the Early Rose was dead August 21, and many of the earlier varieties were marked ripe August 24. The foliage of the later varieties was destroyed by the blight.

Large vs. Small Tubers for Seed.

Computing the average of the forty-five varieties in which one row was planted with cuttings from a large tuber, and the other from one or more small ones, it appears that the merchantable yield from the large tubers was a little more than one and a half per cent. greater than that from the small ones ; and that the total yield from the large tubers was about five per cent. greater. The difference is so slight that it is hardly worthy of consideration.

Second Planting.

In our second planting of potatoes, we planted only the varieties grown in 1884, of which we had sufficient seed to plant a row of single eyes one hundred feet long. The ground was less highly fertilized than that used for the first planting. It received a moderate application of barn-yard manure in the fall of 1884,and during the following winter; the manure being plowed in, in the spring, previous to planting the potatoes. These were cut to single eyes, and the cuttings placed one foot apart in the row; in other words one hundred cuttings of each variety were planted. The rows were three and a half feet apart and were planted May 5th to 9th. The ground was cultivated as often as it seemed to require it until the tops commenced to fall; and sufficient hand work was done to keep the rows nearly or quite free from weeds.

The crop from this planting rotted so seriously that the weights were undoubtedly affected in many varieties. As will appear from the following table of yields, several sorts were a total loss. In some cases, as in the varieties of which the yields are omitted, the tubers were so far decayed as to render weighing impossible. The figures given express as nearly as could be obtained the actual yield.

The yields of the different varieties and the per cent. of rotten tubers, are given in the three right hand columns of the following table :

POTATO — A TEST OF VARIETIES — SECOND PLANTING.

	Tip Eyes.					Eyes for Comparison.				Total Yield.		
	Number of eyes.	Number merchantable.	Weight of merchantable.	Total number.	Total weight.	Number merchantable.	Weight of merchantable.	Total number.	Total weight.	**Weight of merchantable.**	**Total weight.**	Per cent rotten.
			lb. oz.		lb. oz.		lb. oz.		lb. oz.	lb. oz.	lb. oz.	
Adirondack	22	56	13 11½	202	23 3	58	22 13	175	30 15	85 2	116 6	67
Almo	19	31	11 1	95	15 1½	45	17 8	247	27	95 6	134 9	69
American Giant	12	31	11 11	70	14 11	56	22 10	99	26 12½	136	172 14½	93
Andrus, White Rose	26	29	7 11	131	14 0½	65	20	211	32 9½	73 2	101 15	99
Astonisher	20	32	11 14	63	14 6	33	13 14	67	16 7	77 3	121 6	39
Baker's Imperial	15	53	11 0½	88	15 8½	40	12 2½	108	18 7½	78 15	113	95
Beauty of Rochester	..	25	7 11½	78	11 12½	48	15 6	112	21 13½	60 9½	95 8	96
Belle	17	25	8 14½	46	11 9½	46	27 7	67	29 15	*	*	100
Big Benefit	26	41	14	169	22 12½	53	19 6	158	30 10	49	81 10½	98
Bliss No. 12	10	19	4 5	91	8	22	6 4	90	12 1	86 14	145 7	49
Bliss No. 30	7	7	1 6	45	2 14	16	4 6	62	7 9	47 2	79 13	96
Bliss No. 39	16	8	1 12	63	4 11	16	5 4½	101	12 6	22 13	51 5	87
Bliss No. 51	8	----	--------	69	3 11	13	2 12	83	6 10	42 8	89 14	52
Bliss Triumph	9	7	1 9½	41	3 11	10	3 6	42	5 14	38 4½	67 2	60
Blush No 2	11	23	4 15	131	12 10	27	7 5	114	14 1	49 1	97 1	33
Boston Market	8	7	1 15	37	4 5½	15	4 2	55	7 5	71 13	110 10	88
Breese's Advance	18	18	5 6	30	6 12	14	8 6	23	9 5½	118 8	138 3½	83
Breese's Red	11	40	11 15	82	16 10	37	7 3	83	11 6	108 15	138 2	36
Brownell's Best	11	22	6 4½	65	10 2	43	13 13	95	18 8	78 13½	107 2	99
Cap Sheaf	11	14	3 13	50	7 8½	9	2 15	40	6 12	*	*	100
Champion of America	..	23	10 2	43	13 2	23	11 12	39	15 2½	--------	--------	100
Charter Oak	12	17	4	71	8 5	41	6 4	63	10 4	61 11½	108 10½	82
Chicago Market	7	15	5	42	6 7	10	3 14	70	9	--------	--------	100
Clark's No. 1	9	20	6 7	60	10 1	28	11 1	91	15 13	*	*	99
Collum's Big Ben'fit	..	----	--------	----	--------	----	--------	----	--------	--------	--------	100
Collum's Superb	6	18	6 9	37	8 10	23	9 9	35	10 9	71 10	93 1½	92
Conqueror	9	13	5 2	24	6	23	9 1½	44	11 1½	96 6½	114 10½	91
Corless Matchless	9	20	7 5½	51	10 5½	29	11 5	58	13 12	102 4½	137 8½	97
Crandall's Seedling	8	10	2 4½	27	4 1½	18	5 10	31	7 1	44 2½	61 13½	50
Dakota Red	7	15	6 2	23	7 0½	11	6 15	22	8	133 8	157 12½	69
Defiance	14	48	10 14	158	17 11	55	17 9½	150	25 11½	108 4½	172 11½	58
Dunmore	10	13	5	26	6 5	21	9 15	38	12 1	†	*	94
Early Blush	9	6	1 2	74	5 9	17	4	72	8 4	38 8½	82 14½	77
Early Electric	8	18	6 7	50	8 5½	7	2 7½	28	3 15	52 3½	78 8½	83
Early Harvest	8	16	5 15½	54	9 4½	32	8 13	66	12 3	*	*	97
Early Household	14	7	1 8	44	3 2	18	5 2½	73	9 12½	*	*	100
Early Maine	9	18	5 6	74	10 1	22	8 13	56	11 13	*	*	96
Early Mayflower	14	15	3 10	81	8 10½	35	8 8½	125	14 13½	50 4½	84 11	79
Early Rose	9	8	1 12½	31	3 7	17	4 9	51	7 1	53 1½	89 6	76
Early Snowflake	14	7	1 7½	53	4 13½	19	5 4	79	11 4½	46 0½	85 1	76
Early Sunrise	10	19	5 13	56	8 12	24	6 8	50	8 6½	69	103 8½	94
Early Telephone	14	----	--------	----	--------	----	--------	----	--------	†	†	100
Early Vermont	9	9	3 4½	40	6 9	19	5 11	54	9 15	†	†	100
English Champion	11	12	3	38	7 7	14	5 6	75	10 1	52 4	98 12	100
Exemus Rose	6	10	3 14	23	5 3	10	5 12	28	7 6	47 12	67 3	100
Farina	7	----	--------	32	2 9	8	1 7	25	2 15	†	†	96
First and Best	8	15	3 15	37	5 14	24	7 14	43	9 12	63	88 3	32
Flesh Colored	8	14	3 10	36	4 4	21	7 6	50	9 14	49 2	81	7
Garnet Chili	6	9	2 5	18	3 8	11	4 12	25	6 11	66 1	88 8	77
General Hancock	..	23	5 11	61	8 8	33	10 5	84	23 14	80 10	128 12	100
Grange	9	19	8 12	77	12 3	22	9 1	92	14 3	†	†	93
Gypsy	11	18	5 11	54	8 11	21	9 12	38	11 8	95 7	101 4	96
Hall's Early Peachblow	5	15	4 12	52	6 2	12	5	17	5 7	†	--------	47
Home Comfort	8	16	4 1	41	5 9	21	5 4	37	6 11	89 8	114 10	77
Howard	8	15	4 4	45	6 6	21	8 9	57	11 5½	64 6½	108 7½	84
Intermediate	..	1	5	43	7	4	1 6	37	1 13	†	†	99
Invincible	9	----	--------	----	--------	----	--------	----	--------	109 9	160 7	100
Iroquois	7	1	4	13	13	10	2 15	23	4 3	17 3	38 9	83
James Vick	8	12	3 1	39	5 2	20	7 2	49	9 10	81 15	126 3	94
Jone's Prizetaker	7	11	3 7	32	4 9	20	5 10	57	8 3	88 7	130 4	97

*Rotten. † This row not full length.

POTATO — *Continued.*

	Tip Eyes.					Eyes for Comparison.				Total Yield.		
	Number of eyes.	Number merchantable.	Weight of merchantable.	Total number.	Total weight.	Number merchantable.	Weight of merchantable.	Total number.	Total weight.	**Weight of merchantable.**	**Total weight.**	Per cent rotten.
			lb. oz.		lb. oz.		lb. oz.		lb. oz.	lb. oz.	lb. oz.	
Jordan Prolific	7	6	1 9½	16	2 9½	16	4 12	27	6 7	15 13½	23 4½	100
Jumbo	8	12	3 12	32	5 3	13	4 9	40	6 14	68 3	110 15	97
Late Beauty of Hebron	7	6	15	21	2	4	10	32	2 7	19 2	42 11	98
Lee's Favorite	9	13	2 14	38	4 13	22	6	77	10 4	62 5	94 2	97
Luxury	13	16	2 2	73	6 9	29	8 12	93	16 12	68 12	117 15	50
Magnum Bonum	12	14	4 14	22	5 6	32	13 2	46	14 6	77	87 7	74
Mammoth Pearl	7	7	3 4	30	4 10	19	8 5	46	10 1	42 2	54 7	89
Marvel of Beauty	3	8	3 8	11	3 14	12	4	17	4 15	56 7	83 4	90
Mountain Rose	16	10	2 4½	84	6 3	14	3 14½	77	9 5½	24 1	57 4½	46
New Champion	5	9	6 2	15	6 12	18	8 6	18	8 6	99 12	130 15	88
New Eng. Beauty	..	18	4 14	76	10 2	52	14 11	89	19 3	52 5½	74 13½	81
New Gypsy No. 2	8	20	7 14	52	11	28	12	59	15	113	156 1	87
New Roxena	13	40	14 12½	162	24 4½	50	19 7	173	29 1	108 12½	176 9½	79
North Star	8	16	6 14	32	9 2	14	5 13½	22	7 11½	120 6½	141 7½	100
Nott's Victor	8	20	6 4½	70	10 1½	20	8	79	11 14	104 3½	149 12½	60
O. K. Mammoth	10	35	13	91	17 6	36	16	120	22 4	133 2	176 4	98
Oneida Peachblow	13	28	7 4	104	13 15	38	13 6	77	18 6	83 14	134 6½	100
Peerless Peachblow	10	16	6 6	32	8	20	8 12	40	10 8	85 5	102 13	37
Pennsylvania Belle	9	17	7 5½	26	8 3½	21	9 2	34	10 7	80 11½	96 13½	100
Perfect Gem	9	20	8 9	65	12 8	30	12 12	73	16 8	120 9	152 10	82
President Arthur	10	26	10 12	66	14 7	32	12	67	15	105 5	137 10	74
Pride of America	12	7	1 10	47	2 14	26	6 5	88	10 13	40 3	72 13	53
Queen of the Roses	8	11	4 14½	36	6 14½	28	10 2	56	13 4	94 4½	129 1½	87
Riker's Graft	8	21	7 5	50	10 5	20	6 10	56	10 5	81 3	116 15	96
Rochester Favorite	8	11	2 13	29	4 9	22	9 10	37	10 11	108 2½	123 14½	61
Rocky Mount'n Rose	7	14	3 13	36	5 15	15	6 3	34	8 7	66 14	95	64
Rogers No. 4	12	38	17	73	20 4½	33	11 15	81	15 14	74	100 9½	92
Rogers No. 7	12	31	10 13	75	14 5	30	10 11	88	16 10	94 13½	141 12½	26
Rose's Invincible	8	20	7 1	55	10 3	26	11 11	59	15 12	103 7	133 10	....
Rose's New Seedli'g	14	18	5 1	86	10 6	18	4 15	98	10 13	35 2	82 11	100
Rose's Red Rose	7	12	2 15	41	5 4½	19	6 6	53	8 8	80 3	114 6½	85
Rosy Morn	9	16	4 8	67	8 15	22	7 7	70	11 3	40 11	82 8	77
Rubicund	13	26	9 1½	74	12 14	40	13 1	113	19 1	83 15½	124 7	95
Rural Blush	11	18	6 3	64	9 9	18	8 6	57	12 2	120 2	147	63
Schoolmaster	9	16	5 7	35	7 12	42	17 6	81	20 11	115 12	145 15	90
Scottish Champion	8	4	1	37	4 1	10	2 8	45	6 8	21	58 5	36
Seedling from Alexander	9	2	13	45	2 12	19	5 4	61	8 14	20 5	50 11	87
Seedling from E. L. Coy	8	15	6 2	33	8	23	10 1	51	12	101 2	133 6	55
Seneca Chief	8	10	3 6	27	4 4	20	9 2	62	11 8	63	90 10	75
Steele's Red	7	7	10	17	2 2	10	3 4	24	5	23 10	49	73
Steuben Beauty	10	16	3 10	32	4 11	18	5 7	53	8 5	42 1	68	12
Saint Patrick	7	11	3 11	22	4 12	15	6 8	23	7 11	77 14	97 7	64
Tioga	7	10	3 11	25	4 11	10	6	27	7 5	55 4	71 8	86
Tremont	13	11	2 6	18	3 1	18	4 3	104	10 9	24 5	65 8	56
Tyrian Purple	13	13	4	64	7 12	22	4 7	62	7 3	43 10	75 9	35
Vermont Champion	10	8	1 14	50	2 9	6	1 13	23	3 14	15 4	30 12	72
Vick's Early Gem	9	7	1 11	38	4 5	20	5 15	52	8 11	54 10	83 14	81
Vick's Prize	10	19	7	28	7 14	32	13 6	50	14 8	100 4	119 11	81
Vick's Surprise	7	10	3 2	20	4 3	17	7 9	34	9 9	109 13	141 11	76
Wall's Orange	12	23	6 12	56	10 5	24	9 5	61	13 8	58 7	82 13	92
Weld's Jumbo	9	13	6 11	37	9 5	30	11 14	70	14 14	85 7	112 11	88
Winslow's Seedling	7	8	2 14	22	4 5	11	5 1	44	7 13	70 12	135 11	80
White Chief	10	18	7 13	27	9 3	17	8 10	29	10	92 9	119 9	96
White Elephant	..	....	....	....	....	....	....	....	....	65 1	85 13	....
White Star	9	13	3 12	26	5 2	24	9 14	40	11 8	83 8	98 8	36
White Whipple	12	27	7 14	57	11 12	24	9 7	60	14 1	78 8	106 5	80
Whitney's No. 1	9	10	4 11	28	7 1	15	5 14	32	7 13	86 12	115 6	70
XX	8	7	2	37	5	12	3 11	42	6 11	39 11	73 6	37

Terminal Eyes vs. Other Eyes.

As an experiment intended to furnish evidence upon this question, we planted the tip eyes by themselves, in our entire second planting of 117 varieties. As the seed tubers were being cut to single eyes, the sections containing the terminal clusters of eyes were kept separate from the remainder. These sections, which were on the average about the size of a large chestnut, were planted by themselves, at the beginning of each row. When the crop was harvested, the yield of these eyes, with that of an equal number of eyes taken at random from the remaining part of the tubers, was noted separately for comparison.

The yields of the tip eyes, and of those weighed for comparison, are given in the preceding table.

A careful examination of this table reveals the fact that in 103, out of the 113 comparable varieties, both the merchantable, and total yields of the tip eyes were less than those of the eyes from the remainder of the tuber; while in only four varieties out of the 113, did the merchantable and total yields of the tip eyes exceed those of the eyes from the remainder. The average for all the varieties shows that the merchantable yield of the tip eyes was about thirty-eight per cent. less, and that of the total yield was about thirty-four per cent. less, than that of the other eyes.

In the Station report for 1883, p. 122, the results of experiments similar in kind to this one are noted, in which it appears that the tip eyes when used for seed, gave yields not inferior, but somewhat superior, to the eyes from the center and stem ends of the tubers.

Without assuming to account for the discordant results of the two experiments, we note the fact that during the thirty days succeeding the planting of the plats of 1883, four and fifty-one hundredths inches of rain fell, while during the same time following the 1885 planting, only one and forty-nine hundredths inches of rain fell. In other words, the planting of the experiment of 1883 was followed by unusually abundant rains, while that of the present experiment was followed by comparative drought. The tip sections being smaller than the others, perhaps suffer more in time of drought. In view of the results obtained in 1883, it seems possible that the difference in the yield, in the present instance, is due as much to the difference in size of the cuttings, as to the portions of the tuber used.

The conclusion outlined is that there is safety in large cuttings.

An Average Yield of four Plantings.

Our experience in testing varieties of the potato, has shown that their comparative productiveness is not constant in different plantings, nor in different seasons. It is a matter of importance, however, to discover which varieties give the largest average yield through a series of years. We present a table giving the data that we have on this subject, in which the merchantable and total yields of each variety are given in pounds. The seed used in all the plantings is from, or descended from that planted by the Station in 1883.

It appears that the American Giant gives the largest average merchantable yield, and the Rural Blush the largest total yield, of the varieties from which we have four crops. An arrangement of varieties in the order of their merchantable yield would be preferable, were it not that some of the sorts were omitted in a portion of the plantings.

POTATO—AVERAGE YIELD OF FOUR PLANTINGS.

	Station 1883		Station 1884		Evans 1884		Station 1885		Average.	
	Merchantable.	Total Yield.	Merchantable.	Total Yield.	Merchantable.	Total Yield.	Merchantable.	Total Yield.	Merchantable.	Total Yield.
Adirondack	151	187	40	127	119	124	85	116	99	138
Alpha	14	15	5	25	26	32	--	--	15	24
American Giant	178	203	110	118	140	142	136	173	141	159
Andrus' White Rose	75	116	42	89	--	--	73	102	63	152
Astonisher	38	70	46	55	94	96	77	121	64	85
Baker's Imperial	113	166	62	94	117	142	79	113	93	129
Beauty of Hebron	151	207	65	85	86	92	--	--	101	128
Big Benefit	47	102	59	105	--	--	49	82	52	96
Bliss No. 12	90	134	51	89	66	83	87	145	73	84
Bliss No. 30	45	106	57	75	95	104	47	80	61	91
Bliss No. 39	22	53	20	35	105	124	23	51	42	66
Bliss No. 51	43	90	46	83	91	102	42	90	55	91
Bliss' Triumph	84	112	70	89	--	--	38	67	48	89
Boston Market	92	124	98	123	--	--	72	111	87	119
Breese's Red	118	152	80	92	123	131	109	138	107	128
Brownell's Best	88	134	75	106	--	--	79	107	77	115
Champion of America	104	108	49	72	117	125	--	--	90	102
Chicago Market	104	145	63	84	--	--	--	--	84	114
Clark's No. 1	134	170	72	84	115	116	--	--	107	123
Conqueror	103	142	48	62	98	104	96	115	86	106
Corless' Matchless	96	144	95	116	102	115	102	138	99	128
Crandall's Seedling	145	179	42	63	112	121	44	62	86	106
Defiance	137	201	60	102	102	116	108	173	102	148
Duchess	8	22	6	13	--	--	--	--	7	17
Dunmore	111	180	111	132	--	--	--	--	111	156
Early Electric	63	85	55	67	143	150	52	79	78	95
Early Gem (Vick's)	71	104	71	102	--	--	--	--	71	103
Early Harvest	106	142	55	67	107	114	--	--	89	108
Early Household	37	70	27	46	46	56	--	--	36	57
Early Mayflower	96	140	70	100	--	--	50	85	72	108
Early Ohio	79	103	79	98	--	--	--	--	79	100
Early Rose	71	114	89	107	--	--	53	89	71	103
Early Snowflake	88	135	36	81	85	96	46	85	64	99
Early Sunrise	90	123	95	111	70	83	69	104	81	105
Early Telephone	82	121	63	118	--	--	--	--	72	119
Early Vermont	81	124	83	97	78	79	--	--	81	100
English Champion	81	114	32	69	130	139	52	99	81	105
Farina	80	117	74	104	124	133	--	--	92	118
First and Best	73	96	32	46	--	--	63	88	52	71
Flesh Colored	8	20	21	33	--	--	49	81	26	44
Garnet Chili	84	105	42	49	--	--	66	88	64	81
Grange	161	224	93	115	144	160	--	--	133	166
Gipsy	158	206	65	77	124	133	95	101	110	129
Intermediate	65	86	60	73	--	--	--	--	62	79
Invincible	107	159	61	76	--	--	110	160	92	132
James Vick	115	160	95	106	--	--	82	126	97	131
Jordan Prolific	39	71	71	83	--	--	16	23	42	59
Jumbo	72	119	47	65	--	--	68	111	62	98
Knapp's Snowbank	90	124	--	6	143	146	--	--	77	92
Late Beauty of Hebron	95	143	106	141	139	150	19	43	89	119
Long Pink Eye	8	27	9	33	--	--	--	--	8	30
Luxury	108	178	27	76	117	128	69	118	80	125
Magnum Bonum	125	142	68	119	--	--	77	87	90	116
Mammoth Pearl	115	160	51	68	--	--	42	54	69	94
Manhattan	77	97	--	--	15	19	--	--	46	58
Marvel of Beauty	82	134	79	104	--	--	56	83	72	107
Mountain Rose	50	75	23	40	66	79	24	57	40	62
New Champion	130	160	86	100	83	86	100	131	99	119
New England Beauty	149	170	60	70	64	69	52	75	81	96
Oneida Peachblow	110	165	94	139	--	--	84	134	96	146
Pennsylvania Belle	151	175	80	92	73	75	81	97	96	109
Pride of America	56	91	49	100	--	--	40	73	48	88
Red Elephant	124	148	--	--	47	51	--	--	85	99
Rochester Favorite	141	169	112	124	147	150	--	--	133	147
Rocky Mountain Rose	88	124	106	137	--	--	67	95	87	118
Rogers' No. 4	154	204	93	107	132	144	74	101	113	139
Rogers' No. 7	134	186	111	146	122	128	95	142	115	150
Rose's New Seedling	43	88	86	135	--	--	35	83	54	102

	Station 1883		Station 1884		Evans 1884		Station 1885		Average.	
	Merchantable.	Total Yield.	Merchantable.	Total Yield.	Merchantable.	Total Yield.	Merchantable.	Total Yield.	Merchantable.	Total Yield.
Rosy Morn	129	169	129	142	104	122	41	82	101	129
Rubicund	162	193	65	77	106	109	84	124	105	125
Rural Blush	154	180	109	140	171	175	120	147	138	160
Saint Patrick	128	158	121	129	--	--	78	97	109	128
Scottish Champion	36	75	21	58	--	--	21	58	39	63
Seedling from C. Baldridge	80	94	--	--	62	66	--	--	71	80
Steele's Red	96	131	43	53	--	--	24	49	54	77
Strong's Imperial	71	94	--	--	116	126	--	--	93	110
Tennessee	110	162	116	144	125	133	--	--	117	146
Tyrian Purple	65	106	36	90	91	98	44	76	59	92
Vermont Champion	47	58	18	37	61	67	15	31	35	48
Vick's Prize	92	132	113	145	124	132	100	120	107	132
Wall's Orange	133	151	77	110	--	--	58	83	89	114
White Elephant	148	190	96	132	154	162	65	86	115	142
White Star	179	207	82	104	--	--	83	98	114	136
White Whipple	189	223	65	79	113	119	78	106	111	131
Willey's No. 10	96	114	5	14	--	--	--	--	40	64

Experiments with Tubers taken from Productive and Unproductive Hills.

In our last report, we gave the results of some experiments in planting tubers from the most productive, and least productive hills separately, from which it appears that the tubers taken from the most productive hills yielded a larger crop than those from the least productive hills. As an aid in comprehending our experiments of the past season in this same line, which are in the main, a direct continuation of those of 1884, we quote a few lines from our last report, as follows:

"We selected in the fall of 1883, the most productive hill, and the least productive hill, respectively, from ten of the varieties of potato in the station garden. On the 8th of May last, the largest and the smallest tuber, respectively, from each of these selected hills, were cut to single eyes and planted in the garden, under the conditions noted for the list of varieties; the cuttings of each tuber forming a short row by themselves. Thus there were four short rows of each of the ten varieties, viz : the first containing the cuttings of the largest tuber of the largest hill; the second, those of the smallest tuber of the largest hill ; the third, those of the largest tuber of the smallest hill ; and the fourth, those of the smallest tuber of the smallest hill."

In the fall of 1884, after these rows were dug, and while the hills lay exposed on the ground, we selected from eight of the ten varieties, the most productive hill from the first two rows; that is, from the yield of the most productive hill of 1883; and also the least productive hill from the remaining two rows, or from the yield of the least productive hill of 1883.

On May 2, the largest and the smallest tuber, respectively, from each of these selections, were cut to single eyes and planted, with those of two similar selections made from the White Star potato in 1884; the cuttings of each tuber forming a short row by themselves.

The conditions of soil and the culture given were the same as has been described for the list of varieties.

After the tops had died, the rows were dug, and the tubers assorted and weighed, with the result shown in the following table, in which the yield, given in ounces is calculated *per eye*, in order to place all the rows on, as nearly as possible, equal footing. In order to avoid confusion of terms, we speak of the plantings from the most productive hills as A, and those from the least productive hills as B.

	Number of eyes.	Yield per eye, merchantable.	Total yield per eye.	Weight of seed tuber.	Ratio of yield to weight of seed.
Adirondack :		oz.	oz.	oz.	oz.
A. Largest tuber	8	13.87	22.62	8.03	22.51
Smallest tuber	6	18.75	27.75	2.36	70.66
B. Largest tuber	7	16.35	23.57	2.09	79.08
Smallest tuber	6	16.66	28.08	0.93	179.82
Conqueror :					
A. Largest tuber	20	17.50	21.12	12.57	33.70
Smallest tuber	11	17.45	19.90	3.75	57.70
B. Largest tuber	10	13.00	15.90	2.31	68.77
Smallest tuber	11	9.81	12.72	1.31	106.70
Crandall's Seedling :					
A. Largest tuber	20	7.75	12.00	7.35	32.72
Smallest tuber	13	9.76	13.53	5.10	34.51
B. Largest tuber	15	12.26	16.33	6.36	38.52
Smallest tuber	11	11.36	16.72	3.00	57.66
Defiance :					
A. Largest tuber	11	23.18	35.90	10.13	38,99
Smallest tuber	5	26.70	39.00	4.61	42.30
B. Largest tuber	6	18.66	27.33	--------	--------
Smallest tuber	5	13.10	22.30	--------	--------
Early Mayflower :					
A. Largest tuber	11	11.72	19.63	6.29	34.34
Smallest tuber	7	11.92	16.07	1.07	105.14
B. Largest tuber	8	12.62	19.06	2.71	56.27
Smallest tuber	6	17.16	12.58	1.47	51.36
Early Sunrise :					
A. Largest tuber	18	12.83	19.49	9.88	35.52
Smallest tuber	11	11.72	16.86	2.59	71.62
B. Largest tuber	12	9.50	16.31	4.42	44.28
Smallest tuber	10	8.80	13.00	3.28	39.63
Magnum Bonum :					
A. Largest tuber	12	13.41	14.45	6.41	27.06
Smallest tuber	5	14.30	15.10	2.45	30.81
B. Only tuber	11	13.40	15.18	7.93	21.05
Rural Blush :					
A. Largest tuber	12	24.70	27.91	9.14	31.01
Smallest tuber	10	23.15	28.75	6.61	43.49
B. Largest tuber	11	17.31	22.36	6.31	40.41
Smallest tuber	8	13.12	18.00	3.23	44.58

	Number of eyes.	Yield per eye, merchantable.	Total yield per eye.	Weight of seed tuber.	Ratio of yield to weight of seed.
White Star:		oz.	oz.	oz.	oz.
A. Largest tuber	17	22.76	30.11	6.59	77.69
Smallest tuber	11	13.59	17.77	1.34	145.89
B. Largest tuber	12	17.33	20.24	2.26	107.52
Smallest tuber	7	13.57	17.57	0.90	136.66
White Star Duplicate:					
A. Largest tuber	22	24.72	27.49	6.67	93.32
Smallest tuber	11	20.36	24.54	2.38	109.20
B. Largest tuber	17	24.88	28.20	4.38	109.47
Smallest tuber	7	11.42	12.71	0.37	240.50

Arranging the figures which give the merchantable and total yields of the different varieties so as to bring the yields of the largest, and of the smallest tubers of each class in a separate column, we have a second table, as follows:—

	A.				B.			
	Largest tuber.		Smallest tuber.		Largest tuber.		Smallest tuber.	
	Merchant-able.	Total yield.	Merchant-able.	Total yield.	Merchant-able.	Total yield.	Mechant-able.	Total yield.
	The yields are calculated *per eye* in ounces.							
Adirondack	13.87	22.62	18.75	27.75	16.37	23.57	16.66	28.08
Conqueror	17.50	21.22	17.45	19.90	13.00	15.90	9.81	12.72
Crandall's Seedling	7.75	12.00	9.76	13.53	12.26	16.33	11.36	16.72
Defiance	23.18	35.90	26.70	39.00	18.66	27.33	13.10	22.30
Early Mayflower	11.72	19.63	11.92	16.07	12.62	19.06	7.16	12.58
Early Sunrise	12.83	19.49	11.72	16.86	9 50	16.31	8.80	13.00
Magnum Bonum‡	13.41	14.45	14.30	15.10	13.40	15.18	-- ---	-- ---
Rural Blush	24.70	27.91	23.15	28.75	17.31	22.36	13.12	18.00
White Star	22.76	30.11	13.59	17.77	17.33	20.24	13.57	17.57
" "	24.72	27.49	20.36	24.54	24.88	28.20	11.42	12.71
Average yield	17.24	23.08	16.77	21.92	15.53	20.45	11.67	17.07

‡In this variety, the smallest hill contained but a single tuber.

From the latter table it appears:

1st. That the merchantable yield of the largest tuber of A exceeds that of the largest tuber of B in seven cases out of ten.

2nd. That the merchantable yield of the smallest tuber of A exceeds that of the largest tuber of B in six cases out of ten.

3rd. That the merchantable yield of the smallest tuber of A exceeps that of the smallest tuber of B in eight cases out of nine. (Magnum Bonum omitted.)

4th. That the total yield of the largest tuber of A exceeds that of the largest tuber of B in six cases out of ten.

5th. That the total yield of the smallest tuber of A exceeds that of the largest tuber of B in five cases out of ten.

6th. That the total yield of the smallest tuber of A exceeds that of the smallest tuber of B in seven cases out of nine. (Magnum Bonum omitted.)

7th. The average of the columns shows a regular descending gradation in the yield from the largest tuber of A to the smallest tuber of B, and that the average yield of the smallest tuber of A exceeds that of the largest tuber of B.

8th. It appears that the largest tubers in each class yielded more than the smallest ones.

These results show a striking similarity to those of last season; and indicate still more strongly that the potato grower may gain an advantage by selecting his seed from the more productive hills. We have made the experiment, and find that this method of selection involves little extra labor. The workmen were instructed to place the tubers of each hill by themselves, and while these lay drying, a man with basket in hand, passed over the rows, and picked up each strikingly productive hill. Our results indicate that it would be better still to select only the larger tubers from these hills. Of course where the potato crop is dug by machinery this method of selection becomes impracticable. We are prepared to repeat next season the experiment of growing potatoes from seed taken from selected hills, on a much more extended scale.

Of how much value to the growing plant is the stored nutriment of the seed tuber, or section?

In relation to this question, we give the results of two experiments, either of which, alone, would seem to offer a satisfactory answer, but strangely enough, the results are contradictory. The conditions of the two experiments were not however the same; one having been performed during the winter, in the greenhouse, and the other in the summer, in the garden.

The details of the first experiment were given in the Station Bulletin, No. 115, which we quote in full.

The absorption of the seed tuber of the Potato during growth of the plant.

The question as to how much of the matter of the planted tuber, or section of tuber, is absorbed by the growing potato plant, has a bearing upon the practical culture of potatoes. If the substance of the tuber, or cutting, serves as food to the plant, the deduction would be that on poor soil, it would prove advantageous to use whole tubers, or large cuttings for planting. In order to gain information upon this question, nine tubers of the White Star potato, of nearly equal size, were selected on Dec. 23, 1884, and the weight of each carefully noted.

Three of these, Nos. 1, 2 and 3, were cut into thin slices and dried at 212° Fahrenheit, to determine the dry matter. Three others, Nos. 4, 5 and 6, were planted in the greenhouse, in twelve inch pots filled with potting soil, consisting of equal parts fine loam, lake sand, muck and sifted manure, well mixed. One tuber was placd in each pot. The remaining three, Nos. 7, 8 and 9, were planted in a similar manner, in sifted lake sand of rather coarse texture.

By March 30, 1885, the more advanced stems of the plants growing in both the potting soil and sand had formed flower buds. The planted tuber, from one pot containing the sand, and one containing the potting soil, was removed and the dry matter determined.

On April 29th, the planted tuber from a second pot containing each of the two soils was removed and dried, and on May 29th, the remaining planted tubers were removed, but unfortunately the one from the sand was somewhat decayed, so that its weight could not be determined.

The results obtained appear in the following table, in which the weights are given in grammes.

Number of tuber.	Weight on Dec. 23, 1884.	Date when removed from pot.	Dry matter.	Per cent. of dry matter, calculated on the weight Dec. 23.	Per cent. of loss on dry matter during growth.
1	282.5 grs.		73.3 grs.	25.444	
2	301.5 “		72.2 “	23.940	
3	277.2 “		61.7 “	22.258	
4	266.9 “	Mar. 30	47.8 “	17.909	25.
7	276.25 “	“ “	43.2 “	15.638	34.
5	323.4 “	Apr. 29	26.4 “	8.016	62.
8	295.5 “	“ “	16.1 “	5.448	77.
6	278.7 “	May 29	6. “	2.117	91.

As the tubers were not equal in weight, we are able to compare their matter only as *percentage.*

The average dry matter of Nos. 1, 2 and 3, on Dec. 23d, was 23.880 per cent., and Prof. Johnson gives as the average of nineteen analyses of various varieties 24 per cent. In computing the percentage of loss of Nos. 4 to 8, inclusive, we assume that those tubers originally contained 23.880 per cent. of dry matter.

It appears therefore that tuber No. 4, grown in potting soil, lost from Dec. 23rd, the time planted, to March 30th, about 25 per cent. of its dry matter, while No. 7, grown in sand, lost in the same time, about 34 per cent. Tuber No. 5, grown in potting soil, lost from the time planted to April 29th, about 62 per cent. of dry matter, and No. 8, grown in sand, about 77 per cent. Tuber No. 6, grown in potting soil, lost, from the time planted to May 29th, about 91 per cent. of its dry matter.

It thus appears that the matter of the tuber continued to be absorbed by the growing plant, during more than five months of growth in the greenhouse, at the close of which time almost the entire substance of tuber No. 6 had been taken up.

It appears also that the absorption was somewhat greater from the tubers planted in the sand, than from those in the potting soil. In tubers Nos. 7 and 8, the ash was determined in the remaining dry matter, and was found to be about 50 per cent. more in No. 7 than in No. 8.

It would seem from these data that even on very fertile soil, the stored nutriment in the potato tuber furnishes a more congenial food for the growing plant, than fertilizing elements contained in the soil; and that upon poor soils at least, an advantage may be gained by planting whole tubers or large sections.

Second Experiment.

For the second experiment, four short rows of White Star potatoes were planted in the garden May 30; two of the rows being single eyes, which we designate as Nos. 1 and 2, and the other two whole tubers, which we call Nos. 3 and 4. All the hills vegetated promptly.

On June 22 the soil was removed, with a garden trowel, from one side of all the hills in the four rows, sufficiently to expose the seed tuber or section to view. The seed sections in row No. 1, and the seed tubers in row No. 3 were then carefully plucked from the growing stems and removed from the hills, while those of Nos. 2 and 4 were left intact. The earth was then replaced about the hills. At this time the tops of rows 1 and 2 were three to four inches high, and those of rows 3 and 4 were about six inches high.

Strange to say, no perceptible effect upon the growth of the plants followed the removal of the seed.

October 3 the rows were dug, and the tubers assorted and weighed with the following result:

	Number merchantable.	Weight of merchantable.	Total number.	Total weight.
Row No. 1, single eyes, seed cuttings removed	30	12 lbs. 7½ oz.	50	14 lbs. 15 oz.
" " 2, single eyes, seed cuttings not removed	30	10 lbs. 10½ oz	65	14 lbs. 0 oz.
" " 3, whole tubers, seed tubers removed	41	19 lbs. 4 oz.	85	23 lbs. 11 oz.
" " 4, whole tubers, seed tubers not removed	48	17 lbs. 10½ oz.	90	22 lbs. 1 oz.

Our experience with the yields of rows treated alike, shows us clearly that these results, for the same seed planted, are as nearly equal as could be expected in duplicate plantings, and hence we are compelled to infer that in this experiment the nutriment in the seed tubers or sections was of no value to the growing plants after the date at which those of rows 1 and 3 were removed.

Another experiment on a small scale, was conducted to show the comparative value of *cuttings of different sizes*, and also the *comparative vigor of tip and base eyes.*

On May 7 we selected ten White Star tubers, of nearly equal size, and divided these into two lots of five each. Of the first five, one tuber was left entire, a second had, as nearly as could be measured by the eye, one fifth of its bulk cut away from the stem end, a third had two fifths cut away, a fourth three fifths, and the fifth four fifths. Thus we had of this five, one whole tuber, one section containing four fifths of a tuber, one containing three fifths, one two fifths, and one one fifth; all however containing the terminal end of the tuber uninjured. We then removed from each of these samples all of the eyes except the terminal cluster, by countersinking each eye with the point of a knife, taking care to cut below the cambium layer.

We treated the second five tubers in exactly the same way, except that in every case we cut away the terminal end, and removed all of the eyes except the one nearest the stem. The ten samples were then planted in the garden.

On Sept. 9 the hills were dug, with the following result, in which the weights are given in ounces.

	Terminal eyes.				Base eyes.			
	No. merch.	Wt. of merch.	Whole number.	Total. wt.	No. merch.	Wt. of merch.	Whole number.	Total wt.
Whole tubers	9	75½	9	75½	11	75	13	79½
$\frac{4}{5}$--- “	8	53½	16	63½	8	60	13	68
$\frac{3}{5}$--- “	9	49	12	54¼	8	58½	13	67¼
$\frac{2}{5}$--- “	6	55	10	64	5	47½	8	54
$\frac{1}{5}$--- “	11	71½	11	71½	3	34¾	3	34¾
Average	8.6	60.9	11.6	65.75	7	55.15	10	60.7

From the yield of the terminal eyes, it would appear that the proportion of tuber planted had no relation to the amount of yield, as the smallest section yielded decidedly more than the average. In the base eyes however, the relation appears more direct.

It appears further, from the table giving the yields of the most productive and least productive hills, that the ratio of the yield to the weight of the tuber planted is largest in the smaller tubers.

These results however have been obtained on fertile soil, and in a season of abundant and frequent rains. On poor soil, and in a season of drought, the case might be very different.

Does Pinching the Terminal Shoots of Potato Tops Increase the Production of Tubers?

We know that pinching the terminal shoot of many plants increases the number and vigor of the axillary branches. In the potato plant the tubers are produced on axillary branches, which grow beneath the soil. It seems not improbable, therefore, that pinching the terminal shoots of the stalks, while in vigorous growth, may stimulate the growth of the underground branches, and thus increase the number or size of the tubers.

In order to test this question, we planted eight short rows of Vick's Early Gem potato in the garden May 2. The tubers were cut to single eyes, and the conditions of planting and culture were the same as has been noted for the list of varieties.

On June 22, we pinched off the terminal shoot of the alternate rows, beginning with the first. The flower buds were then just forming. The pinching of the same rows was repeated on July 16. At this time it was evident that the pinching had increased the number of branches above ground.

August 28, the rows were dug and the produce of each row weighed, with the following result:

Pinched rows.		Weight of merchantable.	Total weight.
No. 1		10 lbs. 3¼ oz.	13 lbs. 6 oz.
No. 3		8 lbs. 6 oz.	10 lbs. 9 oz.
No. 5		8 lbs. 8½ oz.	10 lbs. 15¾ oz.
No. 7		9 lbs. 10½ oz.	11 lbs. 14¾ oz.
	Total	36 lbs. 12¼ oz.	46 lbs. 13½ oz.
Unpinched rows.			
No. 2		9 lbs. 13½ oz.	12 lbs. 6 oz.
No. 4		11 lbs. 2¼ oz.	12 lbs. 10¾ oz.
No. 6		11 lbs. 4¼ oz.	13 lbs. 7¼ oz.
No. 8		10 lbs. 2½ oz.	12 lbs. 11½ oz.
	Total	42 lbs. 6½ oz.	51 lbs. 3½ oz.

In this experiment, the pinching appears to have been positively detrimental to the yield of tubers.

Are some Varieties more Subject to Rot than Others?

From the table giving the yields, etc., of the first planting, it appears that there is little uniformity in the per cent. of decay in the yields from the large and small tubers, in the same varieties. Thus the crop of the large tuber of the Boston Market had no rotten potatoes, while sixty-five per cent. of that from the small tuber was rotten. In the Early Telephone, on the other hand, the crop of the large tuber had more than twice as much decay as that of the small one. As these plantings were grown under, as nearly as possible, equivalent conditions, it would appear at first thought that the amount of decay is less a question of variety than of some other considerations.

A comparison of the percentages of decay of the varieties of the second planting, with those of the same varieties in 1883, however, suggests a different conclusion. We present ten each of the varieties in the second planting that decayed most, and that decayed least, giving also the per cent. of decay for each in 1883, as follows:

Most decay.	Pr cent. of decay. 1885.	Pr cent. of decay. 1883.	Least decay.	Pr cent. of decay. 1885.	Pr cent. of decay. 1883.
Champion of America	100	6	Flesh Colored	7	00
Chicago Market	100	18	Rogers No 7	26	4⅓
Early Household	100	3½	First and Best	32	2
Early Telephone	100	26½	Tyrian Purple	35	4
Early Vermont	100	40	Breese's Red	36	0½
English Champion	100	27	Scottish Champion	36	00
Invincible	100	9	White Star	36	3
Jordan Prolific	100	49½	Astonisher	39	0
Oneida Peachblow	100	17	Mountain Rose	46	8½
Pennsylvania Belle	100	39½	Bliss' No. 12	49	3
Average per cent. of decay	100	23.6	Average per cent. of decay	34.2	2.5

It is evident that the varieties that decayed least in 1885, decayed very little in 1883, while those that were a total loss in 1885, were also quite largely decayed in 1883, facts which suggest that the amount of decay may be in some degree due to variety.

It would be interesting to discover whether or not the tendency to decay is co-related with any particular character of the tuber or plant. A comparison of the amount of decay with the vigor of plant, productiveness and season of maturity, in the varieties of the first planting, elicits some interesting facts. From our notes on the foliage we are able to divide the varieties with respect to their vigor of growth, into four classes, viz: those of feeble growth, those of moderately vigorous growth, those very vigorous, and those most vigorous. We present the table classified in this manner, giving the yields (ounces omitted), the number of days from planting to complete death of the foliage, and the per cent. of decay in each of the varieties planted May 1st, as follows:

Varieties of feeble growth.

	Yield per hundred hills.	Number of days from planting to maturity.	Per cent. of rotten tubers.
Beauty of Hebron	96 lbs.	119	33
Bliss' Triumph—large tuber	75 “	110	38
“ small “	36 “	110	16
Boston Cracker	66 “	114	34
Boston Market—large tuber	90 “	117	0
“ small “	85 “	117	65
Diamond	77 “	116	36
Early Essex	123 “	116	17
Early Electric—large tuber	90 “	116	52
“ small “	60 “	116	39
Early Illinois	88 “	116	40
Early Ohio	84 “	116	46
Kennedy	42 “	117	26
Pearl of Savoy	94 “	117	14
Stray Beauty	66 “	116	3
Thorburn	108 “	117	15
Vermont Champion	50 “	121	9
Vick's Extra Early—large tuber	91 “	109	7
“ “ small “	77 “	109	11
White Kidney	43 “	126	45
Average	77 “	116	27

Varieties of Moderately Vigorous Growth.

	Yield.	Days.	Per ct. rot.
Belle—large tuber	123	138	66
“ small tuber	131	138	97
Burrough's Garfield	156	137	92
Colvin's Early White Prize—large tuber	130	119	37
“ “ small “	132	119	17
Conqueror—large tuber	163	119	91
“ small “	132	137	100
Cow-Horn	142	126	42
Crandall's Beauty	121	116	33
Crane's Potentate	130	119	31
Crawford's Seedling	101	117	19
Early Pearl	114	116	18

	Yield.	Days.	Per ct. rot.
Early Perfection	79	117	18
Early Rose—large tuber	99	114	35
“ “ small tuber	88	113	50
Early Snowflake—large tuber	142	119	52
“ “ small “	126	118	28
Early Sunrise—large tuber	192	117	65
“ “ small “	163	119	44
Hall’s Early Peachblow	121	143	50
Harmony	145	147	65
Irish Wonder	188	138	79
Jordan’s Russet	121	126	54
Jumbo—large tuber	110	119	27
“ small tuber	106	138	50
Late Beauty of Hebron—large tuber	88	126	63
“ “ small “	135	141	37
Peck	142	138	66
Pride of America	117	121	30
Queen of the Valley	97	128	80
Rosy Morn—large tuber	145	117	25
“ “ small tuber	122	117	25
Rubicund—large tuber	73	142	90
“ small “	62	142	93
Sunlit Star	109	117	18
Vanguard	114	117	14
Seedling from A. Donald	88	117	—
Seedling from A. B. Lovett	107	119	—
Average	123	126	53

Varieties of very Vigorous Growth.

Adirondack—large tuber	205	142	51
“ small tuber	169	142	33
American Giant—large tuber	181	138	83
“ “ small “	210	138	91
Blood Heart	178	129	92
Bonanza	155	141	79
Brownell’s Best—large tuber	159	140	76
“ “ small “	143	133	85
Chicago Beauty	179	128	92
Chicago Market—large tuber	154	132	91
“ “ small “	136	138	84
Clark’s No. 1—large “	128	138	85
“ No. 1—small “	221	138	92
Colvin’s Excelsior	135	138	58
Dakota Red—large tuber	207	146	37
“ “ small “	186	146	62
Defiance—large tuber	170	141	55
“ small “	279	141	63
Dictator	252	141	94
Dunmore—large tuber	193	138	97
“ small “	162	141	94

	Yield.	Days.	Per ct. rot.
Early Maine—large tuber	205	116	17
“ “ small “	215	117	34
Early Mayflower—large tuber	203	121	30
“ “ small “	165	121	42
Early Mohawk	198	138	80
Early Telephone—large tuber	160	126	79
“ “ small “	173	119	38
Genesee	133	126	95
Improved Pinkeye	133	146	58
Jones' Prizetaker—large tuber	233	128	90
“ “ small “	91	126	95
Lee's Favorite—large tuber	102	116	80
“ “ small “	158	116	33
Magnum Bonum—large tuber	127	126	22
“ “ small “	108	138	62
Mammoth Pearl	159	138	99
Manitoba	122	128	85
McFaden's Seedling	90	119	23
Nott's Victor—large tuber	148	117	23
“ “ small “	146	119	[illegible]
Parson's Prolific	169	140	93
Perfection	197	127	45
Pride of the West	115	138	92
Rose's No. 76	172	146	57
Rose's Purple Blush	177	142	81
Rural Blush—large tuber	219	144	83
“ “ small “	156	144	36
Seneca Red Jacket	143	138	93
Spaulding's Seedling	144	128	64
Stanton	110	142	97
Tioga—large tuber	179	140	95
“ small “	174	142	96
Tyrian Purple	99	121	3
White Lily	97	126	52
White Star—large tuber	173	140	87
“ “ small “	147	140	87
Average	164	133	67

Varieties of Most Vigorous Growth.

Burpee's Empire State	224	141	86
Corless Matchless—large tuber	224	137	96
“ “ small “	194	137	88
Early Vermont—large tuber	222	126	87
“ “ small “	191	126	87
Garretson's No. 8—large tuber	165	138	41
“ No. 8—small “	179	138	44
Great Eastern	199	142	97
Napaug—large tuber	163	144	93
“ small “	160	144	93
New York State	180	142	88
Ogden Beauty	137	138	65

	Yield.	Days.	Per ct. rot.
O. K. Mammoth—large tuber	228	142	27
“ “ small “	202	142	92
Ontario's Jumbo	175	138	91
Prairie Farmer	163	138	90
Pride of Lisbon	147	138	81
Red Star	140	142	95
Rochester Favorite—large tuber	175	142	79
“ “ small “	186	142	75
Rose's Beauty of Beauties	194	138	95
Rose's New Giant	213	138	96
Rose's President Cleveland	88	140	100
St. Patrick—large tuber	143	140	—
“ “ small “	164	140	87
Salt Lake Queen	162	138	82
Schoolmaster—large tuber	192	138	100
“ small “	192	138	76
Tunxis—large “	195	138	76
“ small “	140	138	18
Vick's Prize—large “	195	140	99
“ “ small “	187	138	97
Wall's Orange—large “	190	138	68
“ “ small “	163	138	82
Weld's No. 1	175	138	99
White Elephant—large tuber	190	142	95
“ “ small “	159	142	82
White's Seedling	193	138	78
Winslow's Seedling—large tuber	165	128	46
“ “ small “	194	128	100
Yellow Elephant	187	138	57
Average	179	138	82

Summary.

	Ave. Yield.	Ave. Days from planting to ripening.	Ave. Per ct. of rot.
Varieties of feeble growth	77	116	27
“ moderately vigorous growth	123	126	53
“ very “ “	164	133	67
“ most “ “	179	138	82

From this summary of the four classes, the interesting fact appears that a relation seems to exist between vigor, productiveness, time of maturity and amount of decay; those least vigorous being earliest, least productive and suffering least from the rot.

Whether the increase of decay in the more vigorous sorts is caused by the blight acting more severely upon these, or whether it is because it has a longer time to act, our data do not show. They do seem to prove, however, that a healthy and vigorous growth does not give immunity from the disease.

The Influence of Soil on the Percentage of Water Contained in Potato Tubers.

It has often been remarked that potatoes grown on sandy soil are superior in quality to those grown on clay soil. Our experiment carried on in the greenhouse, of which the details have been already given, gave us an opportunity to note the comparative amounts of moisture contained in the tubers grown on the two soils used. The tubers grown in the sand contained 13.686 per cent. of water, and those grown in the potting soil 19.045 per cent., showing that the latter contained about thirty-nine per cent. more water.

Wild Potato.

We continue to grow the wild potato received in 1883, from Mr. J. G. Lemon, of Oakland, Cal. We have also grown a wild potato from Messrs. Landreth & Son, thought by them to be either *Solanum Fendleri*, or *S. Jamesii*. This was to all appearances, the same as that received from Mr. Lemon in 1883, which we believe has been thought by Dr. Gray to be only a variety of the common potato, and named *Solanum tuberosum* Var. *boreale*. It is certainly very distinct from our common potato. The foliage is quite different in appearance, and we have made repeated attempts to cross fertilize the flowers of the two without success. Neither the potato beetle nor its larvae has fed upon the foliage, the leaves were not affected by the blight, nor were any of the tubers decayed. Unplanted potatoes from the crop of 1884, are still (Oct. 30, 1885) sound, and the eyes have not started. The tubers have not perceptibly increased in size during the three generations of culture at the station.

INSECTS AND INSECTICIDES.

Experiments with the Squash Vine Borer.

In our last report, we gave the results of certain experiments made with the view of discovering a preventive against the injury of the squash vine borer, *Melittia cucurbitae* (Harris). From these it appears that corn-cobs dipped in coal tar, placed among the plants, seemed to have a marked effect in repelling the female insect. It also appears that Paris green mixed with water, and thus applied to the stems, and the kerosene emulsion applied in the same way, proved beneficial by reducing the number of borers.

We have repeated the experiment with the cobs dipped in coal tar; and intended also to repeat the application of the Paris green and water, but the unusually vigorous growth of the vines made it almost impossible to trace out the stems, or even to walk among them, without doing much injury to the plants. We, therefore abandoned this part of the experiment, after attempting the second application. Indeed the labor and care required to apply either the Paris green mixture or the soap emulsion after every hard rain, as would seem necessary, will prove an almost unsurmountable objection where the plants are vigorous. The coal tar remedy, however, is so easily applied, and the odor is so well retained, that it continues its influence long after the ground is completely overrun by the vines. The objection to it is, that it probably does not destroy either the worms or the moth, but only repels the latter, inducing her to deposit her eggs on other vines not thus protected.

Our experiments of the past season have shown one fact that we had not previously observed, viz: that where vines are growing in a plat, and where the growth covers the ground, the injuries wrought by the borer are confined chiefly to the borders of the plat. Owing to this fact, our experiment would doubtless have given more marked results had the hills been planted in one consecutive row.

For the experiments, we used a plat of Hubbard squashes, consisting of eight rows, or 64 hills, planted ten feet apart each way. The seeds were planted June 3, and the hills were covered with plant protectors, to prevent injury from the striped bug. After the plants had made some growth, the protectors were removed, and the hills were thinned where they required it, to four plants each.

On July 22, we placed in each hill of the first and second rows, five corn-cobs, dipped their whole length in coal tar. To the plants of the seventh and eighth rows we applied Paris green and water, at the rate of half a teaspoonful of the poison to two gallons of water, pouring the liquid upon the stems throughout their whole length. About two weeks later, the cobs were again dipped in the coal tar, and the Paris green and water again applied to rows seven and eight. Soon after this time, the vines had made so vigorous a growth, that we found it necessary to defer making further applications of the Paris green and water.

On October 9th and 10th, we made a very careful examination of the vines, scrutinizing each stem and branch separately from its base to its terminus. The treatment of the different rows, the number of plants in each, and the number of borers found, is here given :

Row 1,	which had	31	plants,	treated with coal tar,*	contained	6	borers
“ 2,	“	30	“	“ “	“	2	“
“ 3,	“	24	“	not treated	“	8	“
“ 4,	“	28	“	“	“	19	“
“ 5,	“	30	“	“	“	16	“
“ 6,	“	31	“	“	“	20	“
“ 7,	“	31	“	treated twice with Paris green and water	“	11	“
“ 8,	“	32	“	“ “ “	“	25	“

From the fact that the injury wrought by the borer is confined almost exclusively to those hills that form the boundaries of the plat, it is evident that row No. 1 is comparable only with row No. 8. Even this comparison is unjust, because No. 8 received two applications of Paris green and water, which probably destroyed some of its borers, as is indicated by comparing Row 6, not treated, with Row 7, treated with Paris green and water. Row 2 is comparable only with Rows 4, 5 and 6, because Row 3 was probably sufficiently near to receive some influence from the coal tar.

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*About half of the borers had left the stem when the examination was made. In such cases we counted the cavity formed as a borer.

Calculating the number of borers per hundred plants and bringing the comparable rows together, it appears that

Row 1, treated with coal tar, had 19.3 borers; while
Row 8, had 78.1 borers.

Also, that

Row 2, treated with coal tar had but 6.6 borers per hundred plants; while
Rows 4, 5 and 6, not treated, had 61.8 " " "

From this it appears that row 8 had about four times as many borers as row 1, in spite of the fact that it received two applications of Paris green and water; and that rows 4, 5 and 6 had on the average more than nine times as many borers as row 2.

The result of this experiment in the use of coal tar, taken in connection with that of last season, would seem to make it safe to say that this substance, probably through its offensive odor, acts very beneficially in preventing injury from the squash vine borer. It has the advantages of being very cheap, of ready application and of being quite lasting in its effects. In seasons when the moths are very numerous, and the attack unusually severe, it is possible that much injury would result in spite of this preventive. It is also possible that in case its use should become general over a large extent of country that it would not prove permanently beneficial. At the present time, however, we know of nothing so likely to save the squash crop from its most dreaded enemy, as coal tar used among the plants in some way that is favorable to the constant giving off of its powerful odor.

Paris Green for the Codling Moth.

Spraying trees with Paris green and water has been often recommended as a preventive against injury from the codling moth (*Carpocapsa pomonella*, L.). In order to learn to what extent the harm wrought by this destructive insect may be thus avoided, we sprayed a few of the trees of the station orchard the past season, and on a portion of the trees made careful notes, intended to show as nearly as possible how much benefit resulted from the application. The trees selected for the experiment were eleven in number, of which nine were of the Fall Pippin variety, and the remaining two Rhode Island Greening. On June 3d we sprayed five of the Fall Pippin trees, and one of the Rhode Island Greenings with Paris green and water at the rate of a teaspoonful to ten gallons. At this time the fruits were about the size of a cranberry. Alternate trees were left unsprayed for comparison.

The liquid was applied to the trees by means of a garden engine and the "cyclone nozzle." The nozzle attached to a hose was tied to the end of a light pole, about ten feet long, by means of which it could be raised and lowered at will, for spraying different parts of the tree.

We found this method of application quite laborious. The amount of water that the nozzle would allow to pass through it was so small, that from a fourth to half an hour was necessary to thoroughly wet the foliage of a large tree. We tried attaching two nozzles to the end of the hose, which performed the work considerably faster than one.

On June 5 a very heavy rain fell; and fearing that this had largely washed off the poison, we made a second application of the Paris green and water at the same rate as before.

On June 17, we found on close examination that the larvae of the codling moth were still hatching and entering the fruits, which were at this time about the size of a small cherry. Wishing to make our application as thorough as possible, we sprayed the trees again on the following day, using one ounce of Paris green to ten gallons of water; applying the mixture this time with the so-called Field force pump fitted with the "Boss" nozzle. We found this apparatus very satisfactory. The liquid left the nozzle in a thin sheet, which expanded in width as it rose in the air, and soon became broken up into a fine spray. By the time it reached the height of the tree top it was so finely distributed that it was necessary to hold the nozzle in one position for a considerable time before the water commenced dripping from the leaves. The nozzle could be held in the hand, dispensing with the pole, and by waving it to the right and left the foliage of the tallest apple trees in the orchard could be wet in one or at most two minutes, with very little waste of the liquid.

As the apples began to drop in August, the windfalls were collected and examined, under the sprayed trees, and those not sprayed, and the number of sound and wormy fruits counted. Oct. 5 and 6 the remaining fruit was picked, and assorted, and counted in the same way. The whole number of sound and wormy fruits yielded by each tree and the per cent. (fractions omitted) of wormy fruits upon each was as follows:

Sprayed Trees.

	Fruits not wormy.	Wormy fruits.	Per ct. of wormy fruits.
Tree No. 1 Fall Pippin	1755	225	11
" 3 "	1429	129	8
" 5 "	707	49	6
" 7 "	129	27	17
" 9 "	178	48	21
" 11 R. I. Greening	186	39	17

Average per cent. of wormy fruits from sprayed trees, 13⅓.

Trees not Sprayed.

	Fruits not wormy.	Wormy fruits.	Per ct. of wormy fruits.
Tree No. 2 Fall Pippin	331	291	47
" 4 "	617	247	29
" 6 "	393	309	40
" 8 R. I. Greening	1591	518	25

Average per cent. of wormy fruits from trees not sprayed, 35¼.

Tree No. 10 was sprayed on June 11th, with a kerosene emulsion, consisting of four pounds common yellow hard soap, one gallon kerosene oil, and one gallon soft water, the soap being dissolved in the water, the solution heated to boiling, the kerosene added, and the whole stirred until cold. One pint of the mixture was diluted with twenty gallons soft water, and applied to the tree in the same manner as the Paris green and water. The foliage seemed to be injured considerably by the application, a portion of the leaves turning brown in a few days, as if scorched.

This tree yielded 208 fruits that were not wormy, and 162 wormy ones, or 44 per cent. of wormy fruits.

It appears that the percentage of wormy fruits from the trees sprayed with Paris green and water was about 22 per cent. less than from those not sprayed. In other words, at this rate 100 barrels of apples picked from the sprayed trees would have yielded 22 barrels more fruit free from worms, than the same number from the unsprayed trees. The kerosene emulsion in this case did not seem to prove beneficial.

The cabbage caterpillar (larva of *Pieris rapae*, L.).

This insect was first noticed June 19, but did not abound in sufficient numbers to do much injury at any time during the season. No perceptible damage was noticed until about July 20. For a few days following this date however the caterpillars increased with considerable rapidity. We made two applications of Pyrethrum powder, mixed with three times its bulk of land plaster, allowing the mixture to stand a few hours before making the application, which was done with the Woodason powder bellows. This destroyed the greater part of the caterpillars, but the plaster was not very satisfactory as a diluent for the powder, being so heavy as not to be easily blown from the bellows.

Ice-water applied at mid-day has been recommended as a destroyer of the cabbage caterpillar. Wishing to intensify the conditions as much as possible in testing this, we gathered July 24, a quantity of the worms with sections of the leaves on which they were feeding. We submerged the leaves with the worms in ice-water for a quarter of a minute, after which we removed them to a porch exposed to the full rays of the July sun. The thermometer at the time indicated more than eighty degrees in the shade, and must have reached nearly or quite 100 degrees in the point where the leaves were exposed. In half an hour the leaves were so dried as to be brittle in places, but the worms had sought refuge on the under side of the leaves and exhibited no inconvenience. As this experiment failed so completely, we made no further tests, Prof. C. V. Riley has since written us, that the strong point in this application is not that the ice-water destroys the worms, but that it causes them to curl up, and drop to the ground, after which they are unable to regain their foothold upon the plant. It seems evident however that many would not fall to the ground, but would be caught within the interstices or folds of the leaves, and those that did fall would, in many cases, be shaded by the foliage, so that the heat of the sun would probably be little hindrance to their locomotion.

A parasitic attack.

Early in September, some dead worms were noticed upon the cabbage plants, and others not dead, that appeared to be suffering from a disease. The number of dead worms increased until the first of

October, when they might have been counted by hundreds. We submitted samples to Prof. S. A. Forbes, State Entomologist of Illinois, who thought that they had died from a contagious parasitic disease closely allied to the *flachèrie*, or *schlaffsutch* of the silk worm, a disease of which Prof. Forbes has made an especial study, and of which he furnished an account, which was published in the transactions of the Illinois Horticultural Society for 1883.

There are grounds for hope therefore, that we may in the future be relieved, at least in a measure, from the ravages of one of the most troublesome pests of the garden.

The Cabbage Maggot (larva of *Anthomyia brassicae*).

Early in June, the roots of cabbage and cauliflower plants were found to be infested with the cabbage maggot. The attack was very severe, and for a time it seemed that the crop would be destroyed. On June 13, forty-three maggots were found upon, or within the root of a single plant.

We made applications of the kerosene emulsion to the rootsby removing a little earth about the plant, pouring in the emulsion, and replacing the earth. An ounce of the Standard emulsion (four pounds common yellow hard soap, one gallon kerosene and one gallon water), dissolved in one pint of soft water, repeatedly applied, appeared to have no effect upon the maggots. Remembering the experience of 1883, we feared to use a stronger emulsion.

Prof. A. J. Cook's experiments at the Michigan Agricultural College indicate that there is little danger of making the emulsion so strong as to injure the roots. He writes us that he used an emulsion consisting of one quart soft soap, one gallon water, and one quart kerosene, about the roots of cabbage plants without any harm resulting. He adds that the emulsion of one half this strength proved fatal to all the maggots that it touched. He also used gas lime with excellent results.

We tried a mixture of pulverized earth and mercury, after the manner that has been recommended in California for the Phylloxera, placing a little of the mixture about the plants. This seemed to have a beneficial influence, but was not an entire success. We found some dead maggots in the plants treated, and many of the worms appeared to have left, but we also found some alive, in immediate contact with the mixture.

The cabbage aphis.

About the middle of July, aphides became very numerous on a part of our cabbage plants. We found that an ounce of the kerosene emulsion diluted with one gallon of water, destroyed all that were wet with the mixture. We made an experiment to see whether a badly infested plant can be entirely cleared of the lice, by a liberal use of the emulsion. After removing all dying and shrivelled leaves, we sprinkled the remaining leaves upon both sides, and the stem, using the atomizing bellows, until every part of the surface appeared wet. The plant was temporarily cleared of its parasites, but in a few days it was infested as much as before.

Abundance of rain fell about July 25, and after that, the aphides mostly disappeared, doing no further harm.

Sometimes badly infested plants are relieved of their swarms of aphides mysteriously. A cabbage plant that had been set out for seed at a distance from any others of its kind, was so harrassed with lice during the early part of the season that it made very little growth. On July 6, we noticed that this plant was entirely free from live aphides, though the stem and axils of the leaves were covered with their remains. On the plant at this time was a single lady bird beetle which was dead, and an unfamiliar live insect, which we were unable to identify. This plant continued free from the parasites at the time when those in the garden were most infested.

The Potato Beetle (*Daryphora 10 lineata* Say).

Early in the season, the Colorado potato beetles appeared in unusally large numbers. We passed over the garden plantings almost daily, and gathered them by hand in thousands. Later when the first brood of larvae hatched, we were surprised to discover that the number was very small. Indeed the larvae were not numerous at any time during the season. It would appear from these results that a thorough hand picking of the beetles is one way to avoid damage from this insect.

Many are of the opinion that the beetles are not likely to be injured by the application of Paris green to the foliage. On June 16 we applied a mixture of this poison mixed with land plaster, at the rate of one part to one hundred by weight, to a portion of a plat of potatoes.

A careful examination made next day, showed that at least fifty per cent of the beetles were dead.

It is well known that these insects feed upon the foliage, and we know of no reasons for believing that they are not susceptible to the effects of Paris green when once they have eaten it. It is possible that, were a larger percentage of poison used, the beetles would avoid it, and so escape injury.

The Currant worm (*Nematus ventricosus,* Klug).

The appearance of this insect was noted May 21. On an old plantation of currants it came in large numbers, though on plants set last spring, we failed to find any during the season. On the plants set in the spring of 1884, and heavily mulched with coal ashes, a very few appeared.

The Radish maggot (Larva of *Anthomyia raphani,* Harris).

A solution of carbolic acid has been recommended as a preventive of the attacks of this insect.

On May 2, we applied this solution at the rate of three grammes of the acid, to five gallons of water, to the soil about the roots of a row of radishes in the garden. On May 11, we renewed the application, doubling the amount of the acid. May 18, we repeated it, using eight grammes of the acid to five gallons of water, following with the last named solution on May 23. No benefit resulted from these applications that we were able to detect. It is possible that the plants would have borne a still stronger solution, which might have been efficacious.

The Squash Bug (*Anasa tristis*, De Geer).

This insect appeared in unusal numbers the past season and did considerable injury to the foliage of squash vines. We found that the kerosene emulsion destroys it, when so applied as to wet the lower surface of its body, but when simply sprinkled upon the infested leaves with the watering pot, the liquid falls almost exclusively upon the backs of the bugs, and largely runs off, doing them very little harm.

We recommend making the application with the atomizing bellows, holding the nozzle in such a way as to wet the lower sides of the insects as much as possible.

THE ORCHARD AND FRUIT GARDEN.

The apple trees regrafted in the spring of 1883 have, with a few exceptions, made an excellent growth. Twenty-five of the eighty-five varieties bore a few blossoms, though but four, Cox's Pomana, Haas, Oldenburg and Rome Beauty, matured any fruits. It is of interest to note that nine of the thirteen summer varieties bloomed, eight of the twenty-two autumn, and but eight of the fifty winter varieties.

A considerable number of the trees of the peach, apricot and nectarine, set in the spring of 1884, were destroyed during the last unusually severe winter. These were re-set last spring; though a few others which opened their leaves promptly at the commencement of the season, and were apparently little injured by the winter, have since died.

What we Propose with Fruits.

We have planned to make our system of note keeping with reference to fruits even more complete than the one we have observed with vegetables. A blank book has been prepared, which assigns a page to each variety, and is properly ruled to keep a full history of every sort grown through twelve consecutive years. In this we record the date at which each plant or tree was set; if a tree, the age when set, age when grafted, stock used, etc.; the date of the first appearance of the leaves, and of the flowers, the date of the first and last ripe fruits, the yield of fruits, the time when the first and last leaves fall, the length of each season's growth, notes as to whether this was well or poorly ripened, the date and severity of the frosts of spring and fall, the time of pruning, or fertilizing, the culture or treatment followed, with full notes as to insect injuries, blights, mildews, fungi, or diseases of whatever kind. The value of these exhaustive data are not as yet fully apparent, even to ourselves. We feel confident, however, that they will prove valuable in proportion to the accuracy of their collection, and the number of years they are continued.

The gathering of such data is in itself very laborious, but we hope that the thorough acquaintance with varieties, and the circumstances of growth that this work enforces upon us, may result in the discovery of laws which shall be of value to horticulture.

An Addition to our List of Small Fruits.

Our list of varieties of the small fruits has been heretofore very inadequate. The past season we have enlarged our collection by the addition of the names given below. It will be observed that not all of these are of the later introductions. In certain cases, we have purposely planted old varieties; sometimes because we desired them as standards by which to judge the newer ones, and at others to use their valuable qualities as parents in the production of new varieties.

Of the grapes, one vine of each was planted; of the strawberries, fifty plants of each; of the raspberries, blackberries and dewberries, six plants of each. The strawberry plants were set in two rows each fifty feet long, in one of which it is proposed to allow the runners to grow, and in the other the plants are to be kept strictly in hills.

GRAPES.

Agawam
Barry
Brighton
Catawba
Champion
Concord
Early Victor
Empire State
Eumelan
Highland
Isabella
Jessica
Lady
Lindley
Niagara
Pocklington
Poughkeepsie Red
Prentiss
Rochester
Salem
Ulster Prolific
Wilder
Woodruff Red
Worden

Unnamed seedling from Jas. M. Paul, N. Adams, Mass.

STRAWBERRY.

Bidwell
Charles Downing
Cornelia
Daisy Miller
Garretson
James Vick
Jersey Queen
Jucunda
Jumbo
Kentucky
Legal Tender
Lennig's White
Longfellow
Manchester
May King
Mount Vernon
Mrs. Garfield
Parry
Piper's Seedling
Primo
Prince of Berries
Sharpless
Wilson
Woodruff No. 1

Also, in autumn of 1885: thirteen plants Great American, and three plants of an unnamed seedling, both from R. Johnson, of Shortsville, N. Y.

Raspberry.

Beebe's Golden
Brandywine
Brinkle's Orange
Caroline
Crimson Beauty
Cuthbert
Gregg
Hansell
Lost Rubies
Mammoth Cluster
Marlboro
Miller's Woodland
Montclair
Nemaha
Ohio
Philadelphia
Reder
Schaffer's Colossal
Souhegan
Superb
Turner

Also, in autumn of 1885 : three plants Key's Prolific, and four plants Silver Queen, from R. Johnson, Shortsville, N. Y.

Blackberry.

Agawam
Crystal White
Early Cluster
Early Harvest
Stayman's Early
Stone's Hardy
Taylor's Prolific
Wilson's Early
Wilson, Jr.

Dewberry.

Bartell's
Mammoth

Notes on Grapes.

Six of the grape vines set out in the spring of 1883, bore a small crop of fruit the past season. The first fruits of Moore's Early were fully ripe on Sept. 13, those of Monroe Sept. 17, of Senasque, Amber Queen and Burnet, Sept. 19, and of Lady Washington on Oct. 10.

Of the varieties set in 1883, the foliage of Burnet suffered most from mildew, that of Monroe and Marvin's Centennial suffered considerably. and that of Iona, Amber Queen and Vergennes, was slightly affected. That of Francis B. Hayes, Lady Washington, Moore's Early, Senasque, Duchess and Jefferson, showed little or no mildew.

None of the grapes were affected with rot.

The wood of Senasque and Duchess was much injured during the winter of 1884–5, and that of Moore's Early and Jefferson suffered slightly. The latter was in a more exposed position than the other varieties. None of the vines received any protection.

We made the experiment of inclosing the clusters in paper bags before the flowers opened, in order to see whether the grape will produce fruit as well when self-fertilized, as when it has opportunity for cross-fertilization. We found that the bunches thus inclosed were quite as well formed as those not inclosed, and the berries were fully as large, and contained as many seeds. The variety tested was the Concord.

We desired to secure crosses between the Wild grapes *Vitis labrusca, V. cordifolia, V. riparia,* and *V. aestivalis,* and the Concord and other improved varieties. In this we have been thus far disappointed. *V. aestivalis* has not yet bloomed with us, and the other wild species have bloomed so much earlier than the improved varieties that we have not been able to secure a cross. Last spring we mulched the soil about the wild vines before the frost left the ground, hoping thus to retard the blooming, but in this we were unsuccessful.

Strange to say, the vines of all the wild species except *V. aestivalis*, bloomed profusely the past season, but not one of them set a single berry. We were unable to account for this fact, as the flowers appeared to yield pollen.

Notes on the Strawberry.

In the autumn of 1884, six potted plants each of the following strawberries were planted, of which the note was omitted in our last report. The last three named are Hautbois strawberries. With the exception of the Daniel Boone, all bore a small crop the past season, and we append the date of first bloom, and first and last ripe fruit of each as follows:

	Bloomed	First berries ripe.	Last berries ripe.		Bloomed	First berries ripe.	Last berries ripe.
				Manchester	May 25	June 25	July 25
Bidwell	May 28	June 23	July 13	Mrs. Garfield	" 20	" 22	" 13
Charles Downing	" 25	" 25	" 25	Old Ironclad	" 22	" 19	" 13
Crescent	" 19	" 17	" 14	Prince of Berries	June 4	" 27	" 18
Cumberland	" 25	" 22	" 14	Sharpless	May 25	" 23	" 11
Daniel Boone	--------	--------	--------	Triumph de Gand	" 25	" 25	" 17
Golden Defiance	May 28	June 26	July 15	Wilson	" 21	" 20	" 11
James Vick	" 21	" 18	" 17	Belle de Bordelaise	" 26	" 23	" 18
Jersey Queen	" 29	" 26	" 21	Montreuil	June 1	" 24	" 23
Legal Tender	" 29	" 25	" 16	Royal Hautbois	May 25	" 23	" 15

It appears that the Crescent was earliest, and the Prince of Berries latest. The Crescent gave the largest yield, the James Vick second, and Legal Tender third.

The Mrs. Garfield strawberry, from a plant set in the spring of 1883, fruited with us the first time the past summer. In season it was medium. The fruit was of a bright scarlet color, of medium size, ripened perfectly at the tip, pleasant but not high flavored. The plants were moderately vigorous and productive, and the berries were borne on short foot-stalks, and were largely covered by the foliage.

The foliage of the Wilson Strawberry, in a bed set in the spring of 1883, blighted so badly during the latter part of the past season as to nearly destroy the plants. The blight was much worse in some parts of the bed than in others, portions being almost exempt. Rows of Sharpless and Hervey Davis growing alongside were also somewhat blighted, but in a far less degree. Of the nineteen varieties set in the fall of 1884, Cumberland and Golden Defiance suffered most. None of the varieties set in the spring of 1885 were noticeably affected.

Several seedling plants from the Manchester and Bidwell strawberries came into bearing the past season. Those from the Manchester, on the average, were notably more vigorous and productive than those from the Bidwell. We were interested to note that all of the plants resembled their parents, with two exceptions. Two seedlings from the Manchester were evidently reversions to the wild *Fragaria vesca,* bearing fruit scarcely larger, and no better in flavor, than the plants of this species found growing wild in the fence corners.

A row of seedlings grown in 1882 from seed of the Monarch of the West, and which came into bearing in 1884, bore the past season more, larger, and better flavored fruit, than did a row of Wilson, growing alongside, and set at the same time.

The influence of different pollens vpon the character of the Strawberry.

With the hope of gathering evidence upon this important but unsettled question, we made a few experiments, of which we here give the results.

The cross-fertilization was all done artificially upon potted plants. In order to avoid, beyond question, the interference of insects in the fertilization, the plants were removed to the green-house when the first flowers were about to open, and inclosed in a frame covered with mosquito netting. To avoid currents of air, the pots were set aside from the ventilating doors. The frame covering the plants was kept fastened to its place, and was never raised except to perform the work of cross-fertilization. The varieties experimented with, were the Crescent and Sharpless. The Crescent blossoms produced no fertile stamens. The stamens from the Sharpless blossoms were removed, either before the petals opened or immediately afterward. It was found difficult to remove the stamens before the petals opened, without mutilating the receptacle more or less, and hence in the majority of cases these were removed immediately afterward. In all cases where there was the least doubt as to whether or not the stamens were capable of giving off pollen, the flower was discarded and removed. In the Sharpless fertilized with Sharpless, the flowers were castrated the same as when fertilized with other pollens.

At first, difficulty was experienced in securing pollen for the fertilization, but after a few trials, it was found that by picking the blooms shortly after the petals opened, and spreading them in a still room for 24 hours, the pollen was given off in abundance. It is probable that the partial drying of the pollen sacs causes them to open promptly, and thus to yield their pollen nearly all at once. The cross-fertilization was performed by bringing the stamen in direct contact with the pistil. The pollen of the wild strawberry (*Fragaria vesca*) was used for fertilizing several blossoms of both varieties ; but, to our surprise, not one of these flowers produced a fruit, although the pollen was applied to each at least twice, and with the same thoroughness as in case of the cultivated varieties. After the plants had ceased blooming, they were taken from the greenhouse to a well prepared bed in the garden, where they were removed from the pots and planted out.

As the berries ripened, they were picked and drawn by Prof. Arthur to their exact size and shape. In cases where a single drawing would not suffice to give a correct idea of the form, the fruit was drawn in two positions.

These drawings appeared in full in the *Rural New Yorker* of October 3rd, 1885, p. 659. No differences appeared in the fruits that we were able to assign with any degree of certainty to the influence of the different pollens, hence we have not reproduced the drawings here. As it was desirable to save the crossed fruits for planting, the flavor was not tested, but in form, size, color, or firmness, we think that the influence of the cross-fertilizations, if any, was too slight to be discernible. We do not offer the results as conclusive. We have made arrangements for repeating the experiments on a more extended scale next season.

We desire to express our thanks to Prof. W. R. Lazenby and Mr. W. J. Green, of the Ohio Agricultural Experiment Station, to whom we were indebted for potted plants of the Crescent as well as for suggestions in carrying out the work.

Notes on the Raspberry.

We note the date of the first bloom, and of the first and last ripe fruits, with observations regarding productiveness, in our list of raspberries set out in 1882, as follows:

RASPBERRY.	First bloom.	First ripe fruits.	Last ripe fruits.	
Brandywine	June 6	July 13	Aug. 14	Productive.
Caroline	" 8	" 17	" 18	Very productive.
Clarke	" 9	" 10	" 11	Productive.
Cuthbert	" 10	" 10	" 18	Very productive.
Davison's Thornless	" 2	" 2	" 31	Moderately productive.
Delaware	" 5	" 13	" 7	Productive.
Early Prolific	" 5	" 9	" 7	Very productive.
Fastolf	" 8	" 13	" 4	Productive.
Fontenay	" 5	" 13	" 5	"
Franconia	--------	" 16	--------	"
Gregg	June 12	" 20	Aug. 11	Very productive.
Herstine	" 5	" 10	" 7	Productive.
Henrietta	" 6	" 14	" 3	"
Highland Hardy	" 4	" 2	" 1	"
Knevett	" 10	" 14	" 10	"
Mammoth Cluster	" 9	" 13	" 11	Very productive.
Mrs. Wood	" 10	" 14	" 8	Productive.
Naomi	" 6	" 14	" 6	"
Parnell	" 8	" 10	" 7	"
Philadelphia	" 13	" 18	" 8	"
Prosser	" 8	" 9	" 4	"
Palluau	" 3	" 1	" 4	"
Red Antwerp	" 8	" 6	" 6	"
Reliance	" 6	" 13	" 6	"
Seneca	" 8	" 13	" 8	"
Thwack	" 10	" 10	" 7	"
Turner	" 5	" 6	" 4	Very productive.
Vice President French	" 8	" 13	" 13	Productive.
Victoria	" 8	" 14	" 7	Very productive.
Yellow Antwerp	" 12	" 16	" 10	" "

It appears that Palluau, Davison's Thornless and Highland Hardy were earliest; that Gregg and Philadelphia were latest; that Cuthbert and Vice President French were longest in bearing; and that Caroline, Cuthbert, Early Prolific, Gregg, Mammoth Cluster, Turner, Victoria and Yellow Antwerp were most productive.

Seedling Raspberries from few and many Seeded Fruits.

In the summer of 1882, we examined many red and black raspberries with reference to the number of seeds they contained, saving and planting the seeds from a few that contained decidedly more, and decidedly less than the average. When of proper size, the seedlings were planted out, those from the few, and from the many seeded fruits being kept separate. The past summer nearly all of those of the black-cap, or *Rubus occidentalis* type, came into bearing. A difference was discernible in the size and flavor of the fruits produced on the two classes of seedlings; those from the many seeded fruits averaging larger and poorer in quality. Several of the plants from the many seeded fruits bore remarkably large berries, but these were without exception inferior in juiciness and flavor. The berries on the plants from the few seeded fruits were in most cases, about the size of those of the Doolittle, or Mammoth Cluster. One of these was especially well flavored; and of several the flavor was superior.

It is not probable that these differences were due entirely to accident. We regard the result of this experiment thus far, not as conclusive, but as furnishing evidence in favor of few seeded fruits as a means of securing improvement in quality.

We thought it possible that some of the seedlings that bore very large fruits might have value to produce fruit for drying purposes. On experiment, however, we found that these yielded a decidedly smaller percentage of dried fruit than the smaller and more juicy berries.

Notes on the Blackberry.

The following blackberries, of which the plants were set in 1882, fruited the past season. We note the date of bloom, and of the first and last ripe fruits as follows:

	First bloom.	First ripe fruits.	Last ripe fruits.
Brunton's Early	June 11	July 24	Aug. 22
Dorchester	" 9	" 27	" 31
Kittatinny		Aug. 1	Sept. 3
Newman's Thornless	" 12	" 7	Aug. 27
New Rochelle	" 9	" 3	Sept. 5
Snyder	" 8	July 27	" 5
Wachusett	" 4	Aug. 1	Aug. 29

The Brunton's Early was earliest, but was least productive, and has proved least hardy of all. Snyder was most productive, but the fruit was small, seedy and acid. The Dorchester and Kittatinny were most satisfactory.

Notes on Currants and Gooseberries.

The following currants and gooseberries fruited with us the past season. As will appear from the tables, the plants were set at different times. The dates of bloom and of the first and last ripe fruits were as follows:

CURRANTS.	When set.	First bloom.	First fruits ripe.	Last fruits ripe.
Cherry	1882	May 11	July 1	July 10
“	1884	“ 15	“ 3	“ 11
Fay's Prolific	1883	“ 16	“ 8	“ 15
Glorie de Sablons	1884	“ 16	“ 6	“ 11
Versailles	1882	“ 12	“ 6	“ 10
“	1884	“ 15	“ 6	“ 11
London Red	1884	“ 16	“ 6	“ 18
Prince Albert	1882	“ 20	“	--------
“ “	1884	“ 15	“ 6	“ 25
Red Dutch	1884	“ 15	“ 6	“ 11
Short Bunched Red	1882	“ 15	“ 1	“ 10
Victoria	1882	“ 15	“ 1	“ 13
“	1884	“ 15	“ 6	“ 13
White Dutch	1884	“ 15	“ 3	“ 10
White Grape	1882	“ 15	“ 2	“ 10
“ “	1884	“ 16	“ 3	“ 10

BLACK CURRANTS.	When set.	First bloom.	First fruits ripe.	Last fruits ripe.
Baldwin's Black	1882	May 18	July 14	Aug. 3
Black English	1882	“ 18	“ 2	“ 1
Black Naples	1882	“ 18	“ 6	July 31
Lee's Black Prolific	1882	“ 18	“ 7	Aug. 3
Ogden's Black Grape	1882	“ 18	“ 2	“ 8
Missouri Large Fruited	1882	“ 15	“ 21	“ 8
Missouri Sweet Fruited	1882	“ 18	“ 29	“ 3

GOOSEBERRY.	When set.	First bloom.	First fruits ripe.	Last fruits ripe.
American	1882	May 14	July 23	Aug. 25
Downing's	1882	“ 12	“ 23	“ 10
Houghton	1882	“ 13	“ 21	“ 25
Mountain	1882	“ 14	“ 28	“ 23
Smith's Improved	1882	“ 12	“ 18	“ 5
Wellington's Glory? (Eng.)	1883	“ 15	“ 29	“ 14

Fay's Prolific, set late in the spring of 1883, bore a small crop, of which the bunches were of remarkably large size. The foliage is of the deep green, vigorous type of the Cherry currant. Appearances indicate that this variety may sustain the high reputation that has been given to it.

The Cherry and Versailles currants have by some been considered identical. In our tests, the first fruits of the Cherry ripened a few days earlier, which was the only perceptible difference.

Of the Black currants, Baldwin's Black was several days later in maturing its fruit than of others of its class. With this exception, we observed very little difference in them, except that Lee's Black Prolific was rather the most productive.

The Missouri Large Fruited, the *Ribes aureum* of Botanists, is well known from its showy, spicy scented, yellow flowers, which come out in early spring. The fruit is of little value in our climate, being very acid, and produced only in small quantities. It is said, however, to make excellent jelly. The shrub is perhaps more generally prized for its flowers than for its fruits.

The Missouri Sweet Fruited currant, (*Ribes floridum*), is a wonderfully vigorous, spreading shrub, bearing small, black, slightly sweet berries, which ripen late and are of indifferent quality. It propagates from self-sown seed, and self-formed layers. Could a variety of this fruit be obtained having a more decided character to its fruit, it might prove very valuable. The remarkable health and vigor of the plant, and the fact that it seems entirely free from insect injuries, would make it of easy culture and reliable for crop.

Of the gooseberries, Smith's Improved was earliest to ripen, and Mountain Seedling latest. Downing was best in flavor, and with perhaps the exception of Houghton, was most productive. The largest berries of the American varieties grew on Mountain Seedling, though the fruit was more uniformly large on Downing. An English gooseberry, supposed to be Wellington's Glory, bore fruit of very large size, which was entirely free from mildew.

Notes on the Huckleberry.

The plants of the huckleberry, *Vaccinium corymbosum*, set out in the spring of 1883, are still alive, and matured some fruit the past season. We have found difficulty in growing seedlings of this fruit, as the young plants are very delicate, and require the most careful treatment, which, with our numerous other duties, we have not as yet been able to give them.

We made an examination of the flowers of the species noted above, in order to learn at what time the stamens yield their pollen. This seems to be given off immediately before, and for a short time after the corolla opens. By opening the corolla of flowers about to expand, and jarring the blossoms vigorously over a glass slide, we secured pollen in considerable quantities, which is an indication that the flowers may be, at least in part, self-fertilized. Nothing appeared in the structure of the flowers to render artificial crossing difficult.

The flowers appeared to be little visited by insects, with the exception of ants, which secured access to the honey by gnawing a small hole through the corolla tube near the base. This tube is so narrow as to prevent the entrance of any but quite small insects.

An Experiment for the Prevention of Apple Scab.

We made a series of applications intended to prevent the growth of the fungus which produces the apple scab, *Fusicladium dendriti-*

cum Fckl. The tree chosen for the experiment was one of the common Siberian(?) crab that had been very subject to injury from this fungus in previous years.

On May 5th, we syringed one half of the tree with a solution of hyposulphite of soda, at the rate of one pound to ten gallons of water, and repeated the application on May 9th, and May 15th.

During the summer, the foliage appeared less injured by the fungus upon the syringed half of the tree. On Sept. 19 we picked a quantity of fruits from the syringed part of the tree, and from the part not syringed, and assorted each lot into three qualities. In the first quality we put only the fruits not attacked by the fungus, in the second, those attacked in but one place, and there but slightly, and in the third, those much injured. The results appear in the following table, in which the percentage of the fruits of each quality are given for the syringed and unsyringed part of the tree. We also give the weight of 100 fruits in each quality, as an indication of the amount of injury wrought by the fungus:

	Syringed portion.		Unsyringed portion.	
	Per cent.	Wt. of 100 fruits: oz.	Per cent.	Wt. of 100 fruits: oz.
First quality	21.5	19	10.	15
Second "	38.5	16	29.7	13
Third "	40.	13	60.3	8

It appears that in the syringed portion of the tree the per cent. of uninjured fruits was double that in the unsyringed portion, while the percentage of the third quality, or much injured fruits was one half less. It also appears that all of the fruits on the syringed portion were larger in size than those on the unsyringed portion. We also noted that there were many more decayed fruits on the unsyringed portion of the tree.

The indications are, therefore, the hyposulphite of soda proved beneficial. The solution may be applied at the same time as the Paris green and water, where the latter is used for the codling moth, thus avoiding the expense of a special application.

Report of the Assistant Horticulturist.*

Little attention seems to have been given to the systematic study of the root growth of plants, a question closely related to the study of fertilization and culture. This subject therefore again receives careful attention.

The work of 1884 has been continued into the past season, the results of which we give as follows.

July 16. ORCHARD GRASS (*Dactylis glomerata*). Fine fibrous roots fill the soil to a depth of one foot. A large number of the roots reached the depth of 21 inches. A few were traced to the depth of three feet. Roots were traced horizontally a distance of 21 inches when they became so small that they were lost among those of other plants.

TALL MEADOW OAT GRASS (*Avena elatior*). Fine fibrous roots fill the soil to a depth of 12 inches, many reaching the depth of 21 inches. A few were traced to the depth of 30 inches. Roots were traced horizontally a distance of 24 inches from the plant.

July 22. KENTUCKY BLUE GRASS (*Poa pratensis*). Very fine fibrous roots fill the soil to the depth of about 12 inches, many reached the depth of 18 inches. Some very fine roots were traced to the depth of 37 inches. The roots extended horizontally about 12 inches.

July 23. MEADOW FESCUE GRASS (*Festuca pratensis*). The soil beneath the plants was filled with fine fibrous roots to the depth of about 12 inches, several were traced to the depth of 32 inches. The horizontal roots extended 9 inches from the plants.

July 24. REDTOP GRASS (*Agrostis vulgaris*). The majority of the roots extended almost directly down beneath the plants to the depth of 22 inches, a few were traced 40 inches below the surface. Horizontal roots extended about 9 inches from the plants. The roots were somewhat larger than those of the varieties examined heretofore.

MEDIUM RED CLOVER (*Trifolium pratense*). Plants grown from seed sown this season. The tap roots extended nearly perpendicularly downwards to the depth of 34 inches. Branches separated from the tap root throughout its entire length. These were most numerous between three and 21 inches in depth. Some of the branches were traced 12 inches from the tap root.

The roots were larger and the fine fibrous ones were less numerous than in grasses.

MEADOW FOXTAIL (*Alopecurus pratensis*). Fibrous roots filled the soil to the depth of 18 inches; a number were traced 34 inches from the surface. Roots extended horizontally about 18 inches from the plant.

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*M. H. Beckwith.

July 27. BOKHARA CLOVER (*Melilotus alba*). The tap root extended nearly perpendicularly downwards to the depth of 33 inches. The soil was nearly filled with fibrous roots to the depth of 18 inches. Branches from the tap root were traced a distance of 18 inches.

BENT GRASS (*Agrostis canina*). Roots extended nearly vertically downwards, nearly filling the soil to the depth of 20 inches, many reaching the depth of 25 inches. The larger roots had numerous short branches from 1 to 3 inches long. Horizontal roots were traced a distance of 24 inches.

July 29. YELLOW TREFOIL (*Medicago lupulina*). Plants grown from seed sown this season. The tap root extended to the depth of 20 inches. It began to send out laterals at about 3 inches below the surface, many of which were traced horizontally a distance of 15 inches.

WHITE CLOVER (*Trifolium repens*). The tap root began to branch at about two inches below the surface. Many of the laterals extend 9 inches from the tap root. The majority of the roots were within 15 inches of the surface. A few were traced to the depth of 24 inches.

SHEEP'S FESCUE (*Festuca ovina*). Fine fibrous roots nearly fill the soil to a depth of 12 inches; a very few were traced to the depth of 27 inches. The laterals extended about 9 inches on each side of the plant.

July 31. ALSIKE CLOVER (*Trifolium hybridum*). Plants from seed sown this season. The tap root began branching about two inches below the surface, extending to the depth of 28 inches. The majority of the fibrous roots were between two and twelve inches below the surface. Laterals extended about 9 inches from the tap root.

HASSOCK GRASS (*Aira caespitosa*). The most of the fine fibrous roots were within twelve inches of the surface, nearly filling the soil to that depth. Several were traced to the depth of 33 inches. Many laterals extended horizontally a distance of 15 inches.

REED CANARY GRASS (*Phalaris arundinacea*). Soil well filled with fine fibrous roots to the depth of 15 inches; many reaching to the depth of 25 inches. A few were traced to the depth of 33 inches. Laterals extended about 15 inches from the plant. There was a thickened underground stem just beneath the surface.

TIMOTHY GRASS (*Phleum pratense*). Fine fibrous roots occupied the soil to the depth of 15 inches; several were traced to the depth of 34 inches. The laterals were traced horizontally a distance of 12 inches, when they became so delicate that they were impossible to follow.

CUCUMBER. For the purpose of noting the effect of fertilization upon the root growth of the cucumber, two short rows of the White Spine variety were planted in very fertile garden soil as follows: Row No. 1 was planted over a trench containing six inches of well rotted compost, covered with six inches of soil. Row No. 2 was planted without manure. The rows were cultivated as nearly alike as possible.

Aug. 4. Row No. 1; The tap root extended downwards nearly perpendicularly until it nearly reached the manure, when it turned to one side until it reached beyond the manure when it again took a downward direction until it reached the depth of 24 inches. Fine fibrous roots extended from the tap root into the manure, completely filling it with a mass of very fine white rootlets. None of the large roots extended into the manure. The laterals were mostly about 6 inches below the surface, with numerous fibrous roots reaching to the depth of 12 inches from the surface. Many laterals extended a distance of 28 inches from the plant.

Row No. 2. The tap root extended nearly perpendicularly to the depth of 18 inches, when it became too delicate to trace. The larger roots were smaller than those of Row No. 1, but were more numerous, many extending 48 inches horizontally. The fibrous roots were larger and not so numerous, nearly filling the soil to the depth of 12 inches. The roots extended horizontally as far as the vines reached.

From this it appears that the fibrous roots having an abundance of plant food near by, were more concentrated. Those in Row No. 2 extended to a greater distance in search of food. The tap root did not extend deeply into the soil in search of food. Its function perhaps was to supply moisture to dissolve the plant food contained in the manure and render it available. This question can, however, only be answered by further experiment.

Two rows each of White Star potatoes, Top Over corn and Long Red Mangel Wurtzel were planted May 23 for the purpose of noting the effect of root pruning upon the growth of the roots. The roots were pruned July 16 by placing a six inch board alongside of the row close to the plants and cutting to the depth of twelve inches with a spade along the outer edge of the board.

Aug. 4. WHITE STAR POTATO, root pruned. Small fibrous roots had started where the roots had been cut off. The majority of the roots occupied the soil between two to eight inches deep. A few roots extended to the depth of 19 inches. Horizontally, roots were traced a distance of 30 inches from the plant.

WHITE STAR POTATO, not root pruned. The roots extended about the same distances each way as in the former. There were more underground stems, the tubers were more numerous but smaller. There were seven tubers on this plant, and only two on the former. The two tubers were nearly equal in bulk to the seven.

Oct. 19. WHITE STAR POTATO, not root pruned. Roots extended to the depth of 17 inches. Laterals extended 26 inches on each side of the plant. Most of the roots were within 14 inches of the surface.

WHITE STAR POTATO, root pruned. The roots extended laterally only about 12 inches. The majority of the roots were within 18 inches of the surface, numerous roots extended to the depth of 33 inches.

TOP OVER CORN, Row No. 1, July 3. The soil on each side of the row was thoroughly pulverized to the depth of 12 inches. Row No. 2 was cultivated with the hand hoe sufficiently to keep down the weeds.

July 16, Row No. 1. The majority of the roots filled the soil to the depth of 9 inches. A few reached the depth of 16 inches. The soil on each side of the plant was filled with fibrous roots for a distance of 12 inches, many of them extending a distance of 3 feet from the plant.

Row No. 2. The majority of the roots were within 12 inches of the surface. A few were traced to the depth of 27 inches. Laterals extended about 12 inches on each side of the plant.

Oct. 17. Row No. 1. Corn fully matured. The roots filled the soil to the depth of 24 inches also on each side of the plant the same distance. Several roots were traced to the depth of 34 inches. Laterals extended horizontally three feet from the plant. There were numerous fibrous roots the entire length of the laterals that grew upwards to the surface.

Row No. 2. The majority of the roots reached the depth of 17 inches. A few were traced to the depth of 30 inches. Numerous laterals extended 45 inches from the plants on each side.

Oct. 19. Long Red Mangel Wurtzel. The majority of the fibrous roots reached the depth of 16 inches. Many of them extending horizontally 39 inches from the plant, nearly filling the soil with fine fibrous roots to the depth of 8 inches from the surface. The tap roots were traced to the depth of 26 inches. Numerous roots about the size of a wheat straw extended horizontally from the tap root about 8 inches below the surface.

Long Red Mangel Wurtzel, root pruned. The tap roots extended to the depth of 26 inches. Laterals extended horizontally about 45 inches. There appeared to be but little difference in the root growth of this and the plant not root pruned, owing perhaps to the fact that the roots had not extended latterally sufficiently to have been cut off by the spade.

Carrots and Parsnip. Carrots and parsnip seeds were planted in four inch drain tiles so as to prevent the formation of all except vertical roots.

Carrot grown in a four inch drain tile 14 inches long, the tap root after reaching below the tile sent out several roots from which the fibrous ones grew upward to the surface. The tap root extending deeper into the soil.

Parsnip grown in two lengths of four inch drain tile. The tap root extend the entire length of the tiles, sending several roots between the tiles where they joined together. Fine fibrous roots extended from these both upward toward the surface and also downward into the subsoil. Roots also grew from below the second length of tile upward toward the surface. The parsnip measured 30 inches in length and about 1½ inches in diameter, being of an uniform size its entire length.

Tobacco. To observe the effect of manure upon the root growth of tobacco, two plants were prepared in the following manner: Plat G. 16, was covered with stable manure. The manure was spaded in to the depth of 8 inches. After setting the plants, the surface was mulched with hay.

Plat G. 17, had the surface mulched with stable manure after setting the plants.

Sept. 19. Plat G. 16. Roots extended nearly perpendicularly downward to the depth of 24 inches. Roots extended horizontally about the same distance. The majority of the fibrous roots were within ten inches of the surface, very few extending below 12 inches. Roots of the size of a lead pencil were numerous.

Plat G. 17. Roots extended to the depth of 20 inches. Many of the roots extended horizontally a distance of 30 inches. The fine fibrous roots were mostly near the surface. The large roots were not as numerous as in the former plat.

NOTES BY THE DIRECTOR.

In roots which penetrate the soil it is only the youngest parts with their delicate root hairs and papillae that absorb nutriment for the use of the plant. The rate of growth of these roots are probably largely influenced by temperature and moisture, and hence we should anticipate a non-accordance of observations made during different seasons, or in different climates. Thome, in his Botany, notes that the roots of a maize seedling attained their maximum rate of growth at 81° F.; those of the pea, wheat and barley, at 75° F.

I find in my notes the following particulars, which may supplement the observations made at the station.

BARLEY. Messrs. Lawes & Gilbert record that the roots extend between 4 and 5 feet. Professor Beal says the combined length of all the roots of a stem of barley in good soil has been estimated at 128 feet, and in poor soil at 80 feet.

BEET. Walkhoff writes that he has traced the roots as much as 4 feet down, where they entered drain pipes, and quotes Schacht as stating that the fibers of the Sugar Beet penetrate as much as 8 or 10 feet of the soil, and as being found in drain pipes at the depth of 5 feet.

CLOVER. Atwater found clover roots in Maine to extend 3 feet 2 inches deep in a very heavy clay soil, the surface soil being 8½ inches deep. Hon. Geo. Geddes in New York, sent to the State Agricultural Society a root 4 feet 2 inches long. Lawes & Gilbert describe *Trifolium pratense*, the Red Clover, as a very deeply rooting plant with numerous long, thick, tap-shaped roots, more or less branched and with rather thick wavy fibres, provided with nodules, but almost destitute of root hairs. *T. repens*, the white clover, as possessing a long deeply penetrating tap-root, giving off numerous rather thick, wiry, flexuous branches, studded with little tubercles and descending obliquely into the soil. Liebig states that clover roots extend 6 feet into the soil.

Grasses.

DOWNY OAT GRASS, *Avena pubescens*, according to Lawes & Gilbert, has short, creeping, underground root-stocks, and fine thread-like roots, generally superficial, but having the power to descend to a great depth under favorable circumstances.

KENTUCKY BLUE GRASS, *Poa pratensis*, has, according to Lawes & Gilbert, underground stems which give off roots which, as well as those from the stolons, are fibrous, intricately branched, and penetrating very deeply, but forming a dense mat beneath the surface. The form known as June Grass, has roots which in New England, I have traced to seven feet deep, there being many at 2 and 3 feet.

MEADOW FESCUE, *Festuca pratensis*, according to Lawes & Gilbert has a subterranean stock, perennial, somewhat creeping, but rarely producing offsets. The root fibres penetrate more deeply than do those of *F. ovina*, but are not so much branched.

MEADOW SOFT GRASS, *Holcus lanatus*. According to Lawes & Gilbert the roots do not penetrate deeply, but form a dense mat just beneath the surface.

MEADOW FOXTAIL, *Alopecurus pratensis*, according to Lawes & Gilbert, has a long deeply penetrating more or less vertical subterranean root-stock, from which proceed creeping offsets or stolons capable of giving off fibrils. In addition to the main vertical root fibres, there is usually close beneath the surface, a dense leash of horizontal fibrils.

ORCHARD GRASS, *Dactylis glomerata*, according to Lawes & Gilbert, has strong, stout fibrous roots, descending more or less vertically to a considerable depth, and together with other more horizontally disposed fibres matting the soil into a dense ball. The root-hairs, under favorable circumstances, are numerous, long and delicate.

PERENNIAL RYE GRASS, *Lolium perenne*, according to Lawes & Gilbert, has much branched fibrous roots, which penetrate to a considerable depth and give off a dense network of root-fibrils near the surface. The root-hairs are stoutish, sometimes short, numerous; at other times very fine and intricate.

TIMOTHY, *Phleum pratense*, according to Atwater, has roots which in Maine were traced 2 feet 4 inches deep, the depth of surface soil being 1 foot 5 inches.

RED TOP, *Agrostis vulgaris*, according to Lawes & Gilbert has exceedingly fine much branched roots, which descend to a depth of 4 or 5 feet, and also form a mat just beneath the surface. The root hairs are very abundant in damp situations, forming a dense white cobweb-like mass.

ROUGH STALKED MEADOW GRASS, *Poa trivialis*, according to Lawes & Gilbert, has closely matted minute fibrous roots, not penetrating deeply, but forming a dense mat beneath the surface, producing no underground offshoots, but developing, especially in moist weather, creeping branches from the base of the culms.

SHEEP'S FESCUE, *Fescuta ovina*, according to Lawes & Gilbert, is often provided with numerous fine creeping underground stolons. The root fibres are very numerous, fine, with but few hairs, branching in all directions and forming a very dense network just beneath the surface, thereby obtaining full possession of the soil to a depth of from 6 to 10 inches, but not usually penetrating more deeply.

SOFT BROME GRASS, *Bromus mollis*, according to Lawes & Gilbert, has stiff wiry roots not much branched, but sometimes very deeply penetrating, as they were traced on one occasion to a depth of 4 to 5 feet, having lost their wiriness and become fleshy.

SWEET SCENTED VERNAL GRASS, *Anthoxanthemum odoratum*, according to Lawes & Gilbert, has fine, much branched, dense root fibres, forming a dense mat close to the surface, but not deeply penetrating.

YELLOW OAT GRASS, *Avena flavescens*, has branched fibrous roots that do not penetrate very deeply into the ground.

Alfalfa

LUCERNE. According to Gould, the roots will penetrate 1 feet, and Liebig says in some cases it will grow roots 30 feet.

LUPINE. According to Liebig, the roots extend about 7 feet in length.

OATS. The combined length of the roots of oats are stated by Professor Beal at 150 feet.

ONION. According to Gould, onion roots will run down to 3 feet.

PARSNIP. Mr. Mechi gives an instance of a parsnip root extending 13 feet, 6 inches downward and the tip was evidently broken off.

RAPE, According to Liebig, has roots of about 5 feet.

SQUASH. The roots of the squash experimented with by Pres. Clark, were estimated at a total length for the plant at certainly more than 80,000 feet.

WHEAT. Mr. Mechi says wheat roots occupy the subsoil to the depth of 4 or 5 feet.

* Report of the Botanist

The work during 1885 has been mainly in the line of that detailed in the report for last year, that is, the study of plant diseases. The observations which it seems desirable to speak of in this connection are partly in continuation of those already reported, and partly on other diseases. A study was also made of a new parasitic disease, of a noxious insect recently introduced into this country, the clover-leaf weevil; and some notes are given on weeds and their fungous parasites. These topics will be taken up in the following order:

Pear blight,
Spotting of quince fruit,
Rotting of tomatoes,
Rust and mildew of lettuce,
Rotting of cherries and plums,
Disease of clover-leaf weevil,
Weeds and their fungous parasites.

PEAR BLIGHT.

Micrococcus amylovorus B.

The investigation of this disease has been in continuation of last year's work, and has been prosecuted throughout the year. Many of the results obtained have been already given to the public in one form or another †, and to some extent, therefore, the data given in this connection is not entirely new.

The most prominent results of the season's work are the confirmation of the theory that the blight is due to bacteria, and the discovery of the manner in which the germs enter the tree; these topics will be taken up first.

It was stated at the outset in last year's report‡ that the bacterial theory of pear blight, although exceedingly plausible, was yet not fully demonstrated. Both a positive and negative proof were consequently undertaken in order to secure a solid basis for our arguments. The work of last year showed beyond all question that the disease is readily communicated to suitable, healthy branches, by introducing a drop of watery solution of a diseased part, or of the gummy exudation. This watery solution can contain but two potent elements—the bacteria and the accompanying soluble substances—to one of which the results of the inoculation must be due. If the disease is brought about by the deleterious substances which are the product of the organisms activity, as some have claimed for zymotic diseases of animals, then such an inoculating solution, when freed from all bacteria, ought still to be capable of starting blight, although the disease might not progress very far without the presence of specific bacteria to supply the necessary quantity of the poison. To test this point, on July 18, a strong solution made from blighted tissue was filtered through a new porous cell, such as used for small electric batteries (in this and other experiments needing a considerable quantity of material freshly blighted, green fruit was used which had been artificially inoculated). The filtrate was colorless and free from all bacteria; it was used (Exper. 378) to inoculate green fruit (which show results more surely and quickly than branches) of Bartlett pear, and at the same time another fruit on same tree was inoculated with the unfiltered liquid (Exper. 379). In a few days the latter was filled with the peculiar viscid products of active blight, showing that the unfiltered liquid had the elements of disease in it; the former, however, remained wholly unaffected, and a month afterward was still perfectly healthy, having only a slight scar where the inoculation had been made.

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*J. C. Arthur.

†Bulletin II. of this Station, new series; "Proof that the disease of trees known as pearblight is directly due to bacteria," read before the Amer. Assoc. for the Advancement of Science, August 1885, and published in Botanical Gazette, X, p. 343, and in Gardener's Chronicle, XXIV, p. 586; "Pear blight and its cause," American Naturalist, XIX, p. 1177; an oral address to the American Pomological Society, August 1885, and to the N. J. State Horticultural Society, December 1885, not yet published by the societies, but variously reported in many journals; and other less important communications.

‡Third Annual report, p. 357 and 364.

Not to rest so important a matter upon a single trial, however conclusive it might seem, essentially the same experiment was repeated on July 24. Another porous cell was used, and the filtering done as before. This time two Bartlett pears were inoculatea with the unfiltered solution (Exper. 387 and 388), and two with the filtrate (Exper. 389 and 390). Both the former gave signs of blight in three days, by the tissues turning brown for a quarter inch around the puncture; in two days more this had extended to nearly an inch, and No. 387 was removed for microscopic examination. No. 388 was left on the tree six days longer, turning brown nearly throughout; upon cutting open, only the stony and other solid tissues remained, the soft tissues having been changed into liquid by action of the bacteria, and this nearly all escaping at the opening made by the puncture left an unoccupied cavity. But, as in the former trial, the inoculation with the filtrate produced no effect. This is accepted as a complete demonstration that the juices accompanying blight will not induce the disease in any form when freed from the blight bacteria.

Having shown that the juices accompanying the bacteria are incapable of producing the blight, it is desirable to show what action the bacteria will have when thoroughly isolated from all substances, solid and liquid, with which they are usually associated during the active stages of the disease. This was accomplished by a series of artificial cultures in an infusion of corn meal. The infusion was prepared by boiling corn meal with water, and filtering. The colorless nutrient liquid thus obtained was placed in various forms of culture vessels, and sterilized by heating. There was introduced into one of these vessels, in March, a tiny fragment of wood from the interior of a limb of Flemish Beauty pear, in which the disease had been kept alive during the winter, from an inoculation (Exper. 84) of the previous season. Five days afterward, the bacteria from the diseased splinter having multiplied to such an extent as to thickly fill the liquid, a small drop was transferred to another culture vessel with sterilized liquid. It is evident that any substances that could be diffused through the liquid originally introduced with the splinter of wood, unless vitalized and capable of multiplication like the bacteria, would be so much diluted by this process that the drop transferred to the new culture could contain but a small per cent. of the amount first introduced. The second culture remained twenty days when a drop was transferred to a third. This was repeated through six cultures, and from the last, after an interval of about three months from the beginning of the series, a drop was introduced into a Bartlett pear on the tree. If any of the unvitalized substances brought into the first culture along with the bacteria, to which the disease might be ascribed, were still to be found in the drop used for inoculation, the quantity was assuredly so minute as to be inoperative, or to induce the disease in a very mild form. The result of the inoculation was, however, to thoroughly permeate the fruit with the bacteria by the ninth day, and to break down the soft tissues into a viscid liquid in the characteristic manner of the blight. The above table—Series A—gives the record number, the time of infecting, the kind of culture vessel, and the quantity of culture liquid in cubic centimeters used in each successive culture.

SERIES A.

No. of Culture.	Date of Infection.	Kind of Culture Vessel.	Amount of Fluid.
301	March 27	Salmon culture tube	20 cc.
302	April 1	Salmon culture tube	20 cc.
307	April 21	Sternberg culture flask	½ cc.
309	April 24	Sternberg culture flask	½ cc.
310	April 27	Sternberg culture flask	½ cc.
320	June 5	Test tube with Fol stopper	25 cc.
362	June 13	Bartlett pear on tree	

Another partially independent series—detailed in table B—gave a practically identical result, thus showing that it was by no means a matter of accident.

SERIES B.

No. of Culture.	Date of Infection.	Kind of Culture Vessel.	Amount of Fluid.
301	March 27	Salmon culture tube	20 cc.
302	April 1	Salmon culture tube	20 cc.
307	April 21	Sternberg culture flask	½ cc.
309	April 24	Sternberg culture flask	½ cc.
314	May 22	Sternberg culture flask	½ cc.
322	June 5	Test tube with Fol stopper	25 cc.
364	July 13	Bartlett pear on tree	

The proof is therefore absolute, so far as a biological demonstration can ever be so, that the specific disease variously known as pear blight, fire blight and twig blight, is caused by the bacteria which are associated with it. For the suggestions which eventually led to this important and satisfactory result, I am indebted to Professor Prentiss of Cornell University.

The bacteria which cause this disease—named by Professor Burrill, Micrococcus amylovorus—are not the bacteria of common putrefaction, or those which accompany the attack of higher fungi, as I have elsewhere shown *, for the latter when introduced into a growing pear are unable to overcome the living forces of the cells, and make no headway in disorganizing the plant's tissues. It is the veriest nonsense, in the face of all the facts now at command, to pretend to account for the presence of bacteria in pear blight by saying that they are everywhere, in the air, in the water, the soil, even in our own mouths, and that when "fermentation" once begins one would expect to find them present as a matter of course. To give the reader some idea of the infinitesimal amount of truth in this assertion, it will be entirely safe to estimate that of the hundreds of kinds and uncountable myriads of individual bacteria about us constantly there is not to be found in a pear limb during active blight a greater ratio as compared with the specific pear blight bacteria, than one to a billion, and it is very doubtful if this is not far too liberal an estimate. There is no greater evidence, furthermore, that the germs of pear blight are constantly about us in the air, than that the germs of diphtheria or small pox are thus omnipresent. The ubiquitous bacteria, which are ever in mind and so constantly referred to, which are the bane of the investigator trying to maintain pure cultures, and of everyone wishing to keep organic matter unchanged, are for the most part quite innocuous, and in the present connection, uninteresting.

The work of last year made it evident that the bacteria (i. e. the specific pear blight bacteria, Micrococcus amylovorus, as these are always meant unless otherwise stated) very likely gained entrance to the interior through the "delicate surface tissues of expanding buds." The observations of this year have so fully confirmed this suggestion as to amount to a practical demonstration. The earliest spontaneous instances of blight were seen June 30, in a small, neglected hawthorn tree in a pasture. A large proportion of the branches bore dead leaves and flowers at their extremities. The fruit on the uninjured parts was at this time two-thirds grown, but on the blighted parts had not advanced beyond the flowering condition. As hawthorns were in flower in this section, about May 15 to 20, it is apparent that they could not have been attacked by the disease later than that date. There was, moreover, satisfactory evidence in the changed appearance of the tissues, that the disease had started in the flowers, or at points where there were no flowers in the tender, growing tip of the branch. The same observations were soon extended to a great number of other hawthorns, and to pears, apples and quinces. The only reasonable conclusion to be drawn is, that

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*Third Annual Report, page 364; Amer. Nat., XIX, p. 1185.

the germs of the disease gained entrance to the interior of the branches through the newest growth of the young shoots and the central parts of the flower, especially the moist nectariferous surfaces, and for the most part not later than the middle of May. It had consequently taken more than a month for the disease, after gaining entrance, to make sufficient headway to kill enough of the leaves to render the injury conspicuous; a result entirely in accord with the observations made on the slow progress of the disease in cool weather, and the long time leaves may remain green after the limb on which they are seated is black with the disease. The generalization is warrantable from these and other published facts that, *as a rule,* the trees are attacked in spring, and the disease passes through a period of incubation of a month or more before becoming sufficiently conspicuous to attract attention, that *in exceptional cases* where shoots still continue to push out vigorously, or through the agency of insects, the attack is later in the season, possibly as late as midsummer.

In order, if possible, to secure some data in regard to the relative action of blight upon different varieties of pear, the following careful experiments were performed. On July 15 half a pear from each of these several varieties—Bartlett, Beurré d'Anjou, Buffum, Doyenné Boussock, Duchesse, Flemish Beauty, Mount Vernon, Seckel and White Doyenné—was laid upon a plate with a very little water, and all placed under a bell jar. A drop of watery infusion of blighted pear was then placed on the cut surface of each. Two days afterward the spot touched by the drop in each was brown, and on the Beurré d'Anjou, Doyenné Boussock and Mt. Vernon were a number of beadlike, milky drops, which in three days longer had become a few large drops. The other varieties now had the brown spot somewhat enlarged, sunken, and covered with dew-like drops the size of a pin head. Three days later and the relative condition was the same. In looking about for an explanation of the divergent action of the three varieties, it was soon found—in placing the half pears on the plate three would not lie level and they were unwittingly trimmed on the lower side, which enabled them to absorb more water from the plate to meet the requirements of the bacteria.

A like experiment was begun July 18. This time a slice half an inch thick from each variety of fruit, made with the most scrupulous care to have all cut alike, was placed on a plate with water and under a bell jar as before. Beside the varieties used in the last experiment there were added Keiffer, Lawrence and Sheldon, being twelve in all. To make the inoculation thoroughly uniform each was touched once with the point of a pin carrying what would adhere to it when put into the creamy portion of a blighted pear. Two days after the Keiffer showed no change, but all the others had a small brownish drop at the point of inoculation, and half a dozen or so colorless drops scattered within a radius of a quarter of an inch from it. No difference in the varieties could be seen, unless the Flemish Beauty and Sheldon were slightly less advanced. Three days later and the surface of each is covered with large drops, even as large as a pea, some of which have coalesced into still larger masses. No difference in the varieties can now be seen, except that the Keiffer is a little behind. In two days longer mould set in and stopped the experiment. In generalizing from this it will not do to place much stress upon the action of the Keiffer pear, as the probability is entirely in favor of the difference being accidental.

The conclusion seems reasonable that so far as the green fruit is concerned, with an equal supply of sap in the different varieties there would be equally rapid and copious blighting. Upon this hypothesis the reason a Bartlett pear gives so much more pronounced results from artificial inoculation than a Seckel or Buffum is due to the larger per cent. of sap it contains. But we do not care to carry this argument far till the investigation is more complete.

From the first announcement that bacteria were the cause of blight, it has been taught that in pruning away the diseased branches the knife should be constantly disinfected with carbolic acid or something equally effective. All experience in artificial inoculation has shown that it is difficult to start the disease in any part of the tree except the young and succulent tissue at the growing ends of the branches or in the flowers and green fruit ; these are not the parts that are usually touched by the knife in pruning, and the precaution urged against spreading the disease with the knife seemed from this to be unnecessary. But there is no argument so good as a rigid demonstration, and hence the matter was subjected to experiment. A knife blade was thoroughly smeared with the exudation of a fully blighted Flemish Beauty pear and was then used to cut off a well ripened twig of this year's growth from a Bartlett pear tree (Exper. 406); this was repeated on three other twigs of same tree (Exper. 407, 408, 409). The trial was varied by cutting off half the length of vigorous sprouts which had started up from the base of two trees with a knife treated as before (Exper. 410, 411, 412, 413). The knife was drawn several times through a freshly blighted branch of Bartlett pear, then used to cut off a branch of present year's growth, fairly matured, on another Bartlett tree; repeated the operation (Exper. 414, 415). The next two experiments (416 and 417) were like the last but on a branch of last year's growth. Of these twelve trials, done with far more thoroughness than is likely to occur in ordinary operations, only the last mentioned one conveyed the disease. The excisions were made on August 5th; an earlier date may have been more favorable to the disease, but on the other hand in practice the limbs are not likely to be cut so near the ends. There can be but one conclusion—that the danger of spreading the disease with the pruning knife is not great enough to warrant the extra trouble of keeping the blade disinfected.

A large number of experiments have been carried on in cultivating the blight bacteria in various nutrient solutions, such as infusions of corn meal, starch, hay, cooked pear, sugar, barn-yard manure and nutrient gelatine, of which corn meal gave the best results and sugar the poorest. In a day or two after introducing the least amount of virus into the culture liquid, say of corn meal, it became turbid with the great increase of the bacteria. In solid gelatine each bacterium formed a spherical colony which became large enough to be distinctly visible, but did not liquify the gelatine about it as is usual with other kinds, and the colony did not long continue to grow. It is not, however, necessary to go into the details of these researches in this connection, the main economic deduction to be drawn is that the germs will grow in dead organic matter outside the tree. This is a more important fact than would appear at first thought. So long as it was not recognized, the mode of transmission of the disease remained obscure. Observation and experiment alike showed that direct infection from a neighboring tree or branch, even though the diseased branches touched the healthy ones, rarely, if ever, occurred ; the bacteria are imprisoned by the bark, or escape in a viscid substance that dries into a hard gum, and hence do not pass directly from the tree into the air; lastly, it has been shown that the germs enter the tree in early spring when but little living pear blight is to be met with. But, knowing that the germs may be propagated in hay infusion, and so far as experiments yet go, without losing any of their virulency, makes it clear that a marsh or any wet land rich in organic matter may sustain the disease, presumably for years, and aided by favorable winds and other conditions be the origin of an epidemic.

The artificial cultures do not develop any transformations in the bacteria other than the formation of zooglœa, which are usually lobulated masses of definite outline. If a pellicle is formed on the liquid, which happens infrequently, these masses occur in it, but they are also scattered through the liquid. Apparently no spores are ever formed.

Some attention has been given to the nature of the chemical changes which the bacteria bring about in the plant. The first and most obvious of these is the disengagement of carbon dioxide (carbonic acid gas). Slicing up freshly blighted pear wood or fruit into a narrow vessel and just covering with water, bubbles of gas will begin to accumulate in course of an hour and gradually rise to the surface. If after a time the gas which has collected above the liquid be tested with a drop of lime water it will give the characteristic white film produced by carbon dioxide.

The change has been said to give rise to butyric acid, but the most careful tests failed to disclose any trace of it. They were made by cutting up a portion of freshly blighted pear limb or fruit, adding alcohol and an excess of concentrated sulphuric acid, and heating. Although a peculiar fruity odor was developed, it assuredly was not that of butyric ether, as would have been the case had any quantity of butyric acid been present. A sound pear under the same treatment gave like results.

It is frequently called a putrefactive fermentation, especially by those who look upon the bacteria as accompanying and not causing the disease, and hence regard their presence as a mere matter of course. There is, however, no good evidence to support the presumption. A weak, not disagreeable but peculiar odor, is perceptible, but it is not the odor of rotting substances. Neither the bulk or time of keeping changes the quality of the odor until other bacteria have taken possession of the mass. The taste of a blighted fruit is not offensive, nor is it peculiarly sweet or sour, but bland and indifferent. This indicates that it is not a putrefactive or even an alcoholic fermentation. Another test was carried out for me by Dr. Babcock, the chemist of the Station. A freshly blighted pear was distilled and the distillate tested by the delicate iodoform process, which consists in adding a little potassic hydrate, boiling and again adding a potassic iodide solution of iodine.* Had there been common alcohol, butyric alcohol or acetic ether present in quantity commensurate with the amount of material used and extent of the change in it, a yellow precipitate would have been seen; but it was absent. To make doubly sure, after allowing sufficient time for subsidence, a drop was taken from the bottom of the liquid and put under the microscope; a very few characteristic hexagonal crystals were thus found. A trifle of alcoholic fermentation had evidently taken place during the blighting, but not so much but that it might well be accounted for by the accidental presence of some true alcoholic ferment in minute quantity. A control test was made by distilling a freshly gathered, sound pear, and treating it in the same manner as in the other case; no trace of crystals could be found. A test of blighted pear with Fehling's solution gave reaction for glucose, but not more than one would get with a raw potato. After all, while there may be some alcoholic or even putrefactive changes taking place during active blight, the total product of the change is far too great to be accounted for by either or both of these together. The substance which is obtained by the action of the blight bacteria on the starch, unlignified cell walls and other substances of the plant tissue, is a very viscid, creamy matter, soluble in water, and drying to a hard gum on exposure to the air. Without further explanation it may be said that so far as observation goes, and so far as tests have been applied, this seems to be one of the viscous fermentations, a class whose physiology and chemistry has been but little studied, and the investigation of which is beset with unusual difficulties.

To sum up the conclusions to be drawn from the work of the year: pear blight, according to rigid proof, is due to a specific kind of bacteria; the germs for the most part gain entrance to the tissues of the tree early in the season through the tender surface tissues of flowers and new shoots; the disease passes through a longer stage of incubation than heretofore recognized; some peculiarities of the disease may be explained by the varying per cent. of sap in the tissues, but the resistance and susceptibility of different varieties has not yet been formulated; the disinfection of the pruning knife is practically unimportant; the germs may grow in many kinds of dead organic matter outside the tree, and on again gaining entrance to it be able to set up the disease in its full virulency; no formation of spores or other transformations except the production of zooglœa have yet been detected; the chemical changes induced by the bacteria in the plant tissues are in part the formation of a gum and disengagement of carbon dioxide, but not of alcohol, butyric acid or any of this series of compounds, at least to any important extent; and lastly the change is not putrefactive or alcoholic, but in all probability viscous.

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*For exact method cf. Prescott's Proximate organic analysis, p. 177.

SPOTTING OF QUINCE FRUIT.

Morthiera Mespili Fckl., var. Cydoniæ, C. & E.

This fungus, Morthiera, which is always present to some extent on the leaves of the quince, and which was partially described in last year's report,* was this year much more prevalent than usual. It did considerable injury to the foliage, in some instances causing it to drop prematurely. It is, however, of the injury done the fruit that I wish to speak especially. On the fruit it forms circular, blackish spots with a red or white margin and a dot or two at the center. The spots are somewhat sunken, and may be as much as a quarter of an inch in diameter. When numerous they coalesce into a deep brown or blackish surface, which may cover a considerable part of the fruit, over which is scattered a great number of minute dots containing the spores. The fruit is disfigured as shown in the cut, and its marketable value is much reduced. Cutting open the fruit shows the pulp to be brown beneath each spot, not deeper, however, than the surface diameter. The limit of the influence of the mycelium is distinctly marked, and paring the fruit rather deeply would remove all traces of it. The edible and keeping qualities of the fruit are not in general materially affected—only its appearance, which detracts from its money value; but if the fungus attacks too early and too vigorously, the growth is checked and the fruit rendered worthless; the latter is fortunately not often the case. No preventive or remedy is yet known.

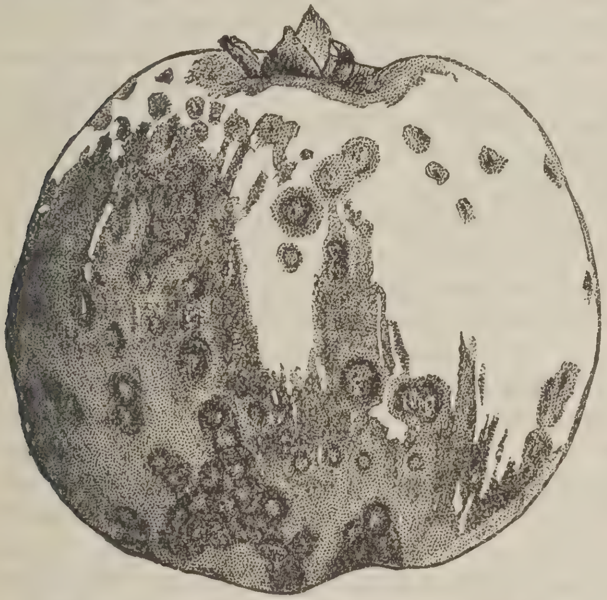

Fig. 1.—Quince spotted with the fungus, Morthiera. Natural size. Original.

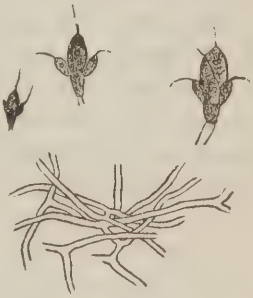

Fig. 2.—Mycelium and spores of quince fungus. Magnified 250 diameters. From 3d An. Rep.

ROTTING OF TOMATOES.

The cause of the rotting of green fruit and the early decay of the ripe fruit of tomatoes, seems as difficult a problem to solve after another year's observation and experiment as ever. The disease, or diseases, appeared this season in sufficient abundance, so that there was no lack of opportunity for observation.

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*Third Annual Report, p. 371.

None of the fungi named in the last report could be traced through the winter of 1884–5, all track of them being lost when cold weather set in. The vines and rotting fruit of a row of tomatoes were permitted to lie undisturbed until time to use the ground in spring of 1885. It was then lightly spaded and tomatoes again set upon it. If the germs of the disease had multiplied in the decaying refuse during the winter, some evidence of it might be expected in its earlier or more abundant attack upon the plants grown at this place; but no such result followed, the plants grew and fruited as finely and as free from disease as elsewhere on the Station grounds.

The general aspect of the malady was somewhat different from last year. The brown rot did not so uniformly start at the apex of the fruit and produce a brown even surface with definite outline. It more often extended in an indefinite manner and gave a wrinkled appearance to the surface. A fungus, which was found in 1884, but from its infrequency seemed unimportant, appeared in great quantities this year. It is Macrosporium Solani E. & M., named in 1882,* and closely related to the Cladosporiums, of which some species is usually to be found associated with rotting tomatoes. It produces by its fruiting a blackish velvety surface not distinguishable by the naked eye from that formed by Cladosporium. The spores are much larger than in the latter fungus and uniformly septate. It is often accompanied by a simple-spored fungus, Phyllosticta Solani E. & M.,† which may, indeed, be but a later condition of it. Dry but fresh spores of the Macrosporium were inserted beneath the skin of a green tomato on September 30. After a number of days the same brown and wrinkled appearance as referred to above gradually overspread the fruit. Whether entirely due to the growth of the Macrosporium spores or not it is impossible to say. The Glœosporium described and figured in the last report‡ was only seen twice during the season, and then in very small amount. Other observations on this topic are given by Mr. Goff, the horticulturist, at page 183 of this report.

LETTUCE RUST.

Septoria Lactucæ Pass.

This disease has been very prevalent on the Station grounds during both 1884 and 1885. It becomes conspicuous about the time the lettuce is large enough for table use. It attacks the oldest leaves first, and gradually works toward the center of the plant.

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*Amer. Nat., XVI., p. 1003. †l. c. ‡Third Annual Report, p. 381.

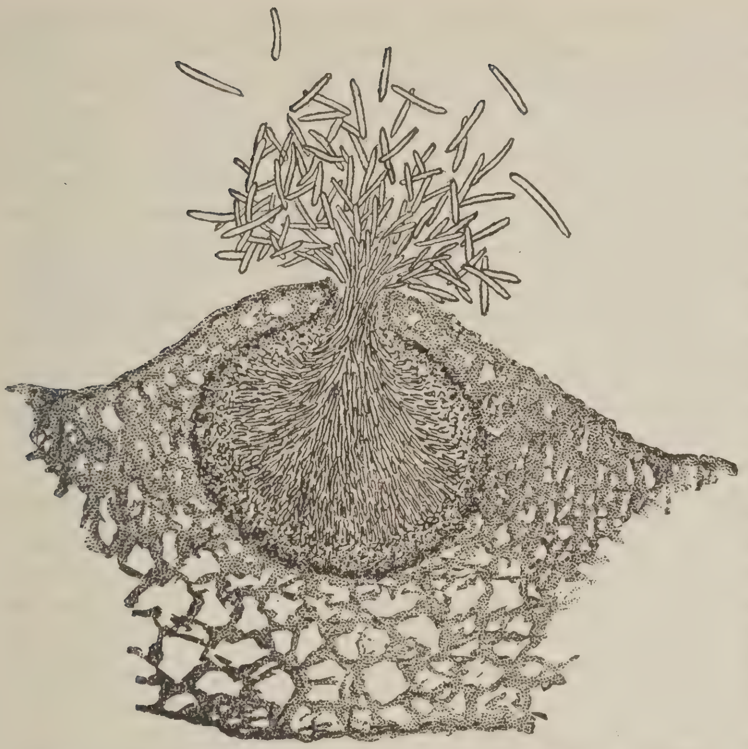

Fig. 3.—Vertical section of leaf of lettuce passing through a perithecium of Septoria Lactucæ Pass. Magnified 250 diameters. Original.

The leaf first turns light then deeper brown, and gives the impression to a casual observer of simply becoming prematurely aged. When the disease is severe the lower leaves die faster than new ones are produced, and the heads of lettuce are consequently rendered unfit for use, or the plants are entirely killed. The presence of the fungus does not appear to change the taste of the lettuce in any way; the injury comes from rendering the leaves less attractive, and from the partial or total killing of the plant.

If lettuce in this condition is examined more closely, both surfaces of the leaf will be found to be covered with minute brown or blackish specks, as fine as pin points, their great abundance giving the rusty color. These specks are the fruiting condition of the fungus which is the cause of the disease. The vegetative threads of the fungus are not visible, being concealed in the tissues of the lettuce; it is, therefore, an internal or endophytic species. Like all such internal growers, the parasite sends its threads through the tissues of the plant, absorbs and appropriates its nutrient juices, and in due time begins the production of spores for its immediate and rapid extension to other host plants. In this case a globular spore-case—perithecium—is produced just beneath the surface of the lettuce leaf, and in this are formed great numbers of single-celled, elongated spores. The perithecium soon opens by a small pore at the top and the ripe spores are forced out from the center by the pressure from the constantly forming spores near the periphery within (fig. 3). The number of spores poured out from a single perithecium is enormous, and when the great number of perithecia which cover each leaf is considered, the provision for complete and rapid extension of the parasite is evidently adequate to explain its utmost prevalence.

The fungus is Septoria Lactucæ Pass. This name applies to the stage described above, in which as a parasite it is doing the greatest injury. The complete, sexual condition is not known, and what becomes of the fungus when the lettuce leaves die is yet to be discovered, for there is a long hiatus between the death and disintegration of the leaves and the reappearance of the fungus the next year, during which time other sorts of spores are probably produced to finally carry the disease to the new crop of lettuce; but all attempts at following the course of development have so far proved unsuccessful. Passerini described the species in 1879,* but had already published the name with specimens found in 1878.† It was also found in the autumn of 1879 by Saccardo,‡ and is undoubtedly common throughout Italy. I do not find it mentioned by German, French or English writers. It is represented by a specimen in Ellis' North American Fungi (No. 345), collected at Newfield, N. J., also in 1879, and was found in the same year by Dr. Forbes, in Illinois, and independently described by Peck as S. Lactucæ,§ but is not named in any local lists of the United States. This indicates that the fungus has only recently become sufficiently abundant to attract attention, or that it is recently introduced into this country.

The fungus usually shows as black or brown specks on the green surface of the leaf, as already described, but occasionally the leaf becomes dead and dry in irregular spots of a half inch or less in diameter on which the specks are more conspicuous. This form has received a separate name, Septoria consimilis E. & M.‖ and appears to be the form that Peck's description¶ applies to. It will, undoubtedly, be found to be merely an incidental condition, but is not, however, mentioned by the Italian observers. At any rate there is no essential economic difference in the two forms, and the technical difference may be left to the systematists.

It is not clear what can be done to prevent the spread of this disease. The fungus being an internal grower, nothing can stop its progress in the plant after once gaining a foothold, but the extermination of the plant itself. To test the effect, if any, of topical applications, a row of (Green Fat) lettuce was thoroughly sprinkled on July 15 with a saturated solution (one part in eighteen hundred) of salicylic acid, and the next row to it with a portion of the same diluted one half. No apparent effect of any sort was produced, either upon the lettuce or the fungus. A row of (Green Dutch) lettuce was sprinkled at the same time with a saturated (10 per ct.) solution of borax. When the water had evaporated, fine crystals of borax remained in places on the leaves. No effect appeared to follow for a time, but after awhile the lettuce was completely killed, and presumably the fungus with it, although the fungus was certainly not killed in advance of the leaf supporting it. If it is necessary to emphasize the fact that external applications are in general nearly or quite useless on internal parasites these experiments will carry some weight.

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*Fung. Parm. in Atti Soc. Critt. Ital., II, p. 35.

†Erb. Critt. Ital., II, 746, and also Myc. Univers., No. 1295.

‡Michelia, I, p. 527 ; II, p. 278. §Bot. Gazette, IV (June, 1879), p. 170.

‖Jour. Mycology, I, p. 100. ¶ l. c.

Lettuce Mildew,

Peronospora gangliformis DeB.

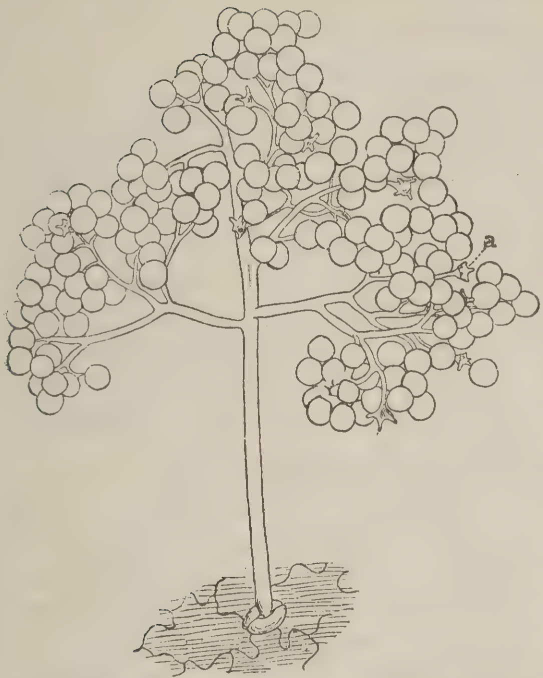

Fig. 4.—A single branch of lettuce mildew arising from the breathing pore of a leaf, and bearing spores; *a* end of a branch from which the spores have fallen. Magnified 150 diameters. Original.

This fungus at first appears in irregular patches half an inch or more across on both surfaces of lettuce leaves, either at first without altering the color, or changing it to a shade or two lighter green, and is visible as minute, colorless down or mold. The vegetative threads of the fungus grow within the leaf and only come to the surface to form spores. It is related to the potato rot and grape mildew, having the same destructive habits on account of which it is sometimes called lettuce rot. When abundant it overspreads the leaves and soon makes them soft and rotten. At first the outer leaves are affected and finally the whole plant may break down into a wet putrid mass. The delicate white mildew on the surface, the only part visible to the unaided eye, is made up of tree-like branching threads (fig. 4) dilated at their extremities (fig. 4 *a*), each of which bears several colorless globular spores. The number borne by a single branch is very large; that illustrated shows probably not more than half the original number of spores, for many dropped off in handling, and the others lay upon each other too thickly to be all drawn.

The disease was observed on lettuce in the garden in September and October, and caused considerable rotting of the foliage. It may occur throughout the season, but is most prevalent in spring and fall. It is not, however, likely to prove very troublesome to lettuce grown in the open air, although Smith* states that it sometimes entirely destroys the harvest of lettuce seed in England; but on early lettuce in the hot bed the reverse is true, and it may and often does sweep away the whole crop. It is especially troublesome through the Alantic states† but is also found westward‡, and may be expected wherever lettuce is forced. The best means known of controlling it is to keep the air about the plants as dry as possible. In the open ground the plants should be thinned and kept free of weeds, and in the hot bed the sash should be raised for the escape of the moisture. The application of lime to the foliage is also said to have some value.

The fungus is common throughout this country and Europe on several species of wild lettuce and allied plants. It is on these that it forms its resting spores, which carry it through the winter and start it the next spring, although they have been found on garden lettuce by Vize[*] in England, and may occasionally occur on it elsewhere.

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*Gardeners' Chronicle, XX, p. 600.

†Halsted, Rep. Conn. Bd. Agr., 1882; Farlow, Bot. Gaz., VIII, 1883, p. 313.

‡Burrill, Bull. Ill. Mus., 1, 1876, p. 55.

ROTTING OF CHERRIES AND PLUMS.

Oidium fructigenum S. & K.

Von Thümen in his work on the fungi of fruits[†] says that undoubtedly this fungus is to be considered the most widely distributed and perhaps the most noxious and destructive of all kinds that occur upon fruit; a statement especially applicable in this country in relation to cherries, plums and other stone fruits. The loss of plums and cherries from rot before they are gathered from the tree is very large, detracting heavily from the profits of their cultivation; this rotting is almost solely due to the attack of this single species. Even after harvesting the rot caused by the growth of the spores of this fungus, which are adhering to the fruit when gathered, adds greatly to the loss of a naturally perishable crop.

The fungus consists of colorless, much branched and septated threads permeating the tissue of the fruit and causing it to turn brown and decay, the surface of the fruit changing to brown, more often a light brown, at the same time. When the fungus produces spores, which does not always take place at once, being largely controlled by the amount of moisture in the air, the surface of the fruit is covered with tufts, more or less distinct and about one sixteenth inch high, of dirty-white or gray pulverulent fruiting threads. The tufts are somewhat compact, but readily fall into dust when rubbed. On apples and similar fruit they are at first distinct and pustular, but soon coalesce and become continuous; on plums and cherries the tufts are generally larger and less regular.

The fruiting threads consist of short sections, each a little more swollen as they approach the ends of the threads where the sections are elliptical. The sections when ripe are separated and form the spores. When well grown in moist air they are abundantly dichotomous, as shown in fig. 5 (one thread is shaded and the other not to render them more distinct), a feature not well shown in any of the illustrations I am familiar with, and Von Thümen[‡] has described and figured them as unbranched. The branches grow at the extremities, giving rise to new spores until the full length and maturity is attained, then the end spores successively drop away.

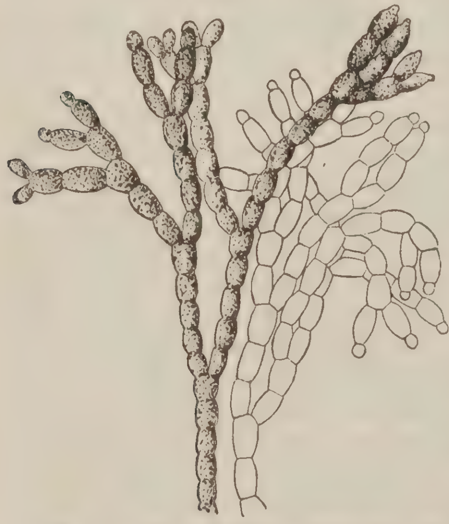

Fig. 5.—Two fruiting threads of Oidium fructigenum, before the spores have begun to fall away. Magnified 250 diameters. Original.

Although this is a common fungus and known almost from the days of Linnæus, it does not seem to have been very carefully studied; European authors are considerably at variance and very brief in their accounts of its habits. It is said by different writers to occur on the green, ripe or fallen fruit. Observations here show it to occur at all stages of the fruit's growth and decay. When the fruit is attacked before it is ripe, it usually remains hanging to the tree through the winter, even till fruit is ripe again, and spores of the fungus are to be found on it during the whole time.

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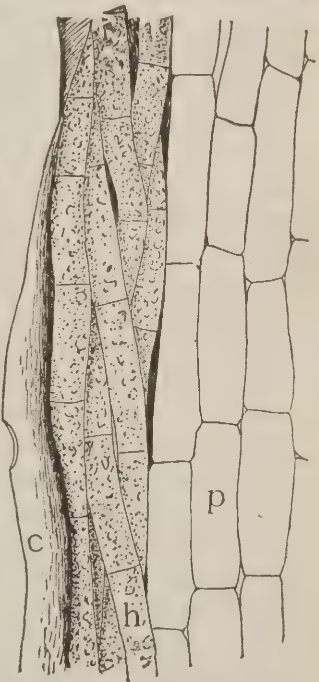
[*] Gardeners' Chronicle, XXI, p. 418, and illustrated in Smith's Diseases of Crops, p. 273.

[†] Fungi Pomicoli, p. 23.

[*] l. c., p. 22, pl. II, fig. 17.

On May 8 a few spores from the dried remnant of a cherry, which had hung on the tree since the last fruiting time, were sown in water on a glass slide. They germinated within two hours by pushing out a vegetative thread from one end. This experiment was a number of times repeated, and the spores always grew with readiness. On May 13 the inner surfaces of several cherry flowers were wet with a drop of water and spores from the same source placed on the moist spots. They were also sown on the moist surface of a leaf and covered with another leaf. The twigs bearing the flowers and leaves were put into water under a bell jar to keep them from wilting. In twenty-four hours the spores had grown sufficiently to kill the tissues about them and turn them brown; in the case of the leaves the discoloration extended through the leaf and was equally conspicuous on the opposite side from the one on which the spores were sown. I could not satisfy myself to what extent or in what manner the fungus had penetrated the leaf, but it certainly found entrance, although it also formed abundant mycelium on the surface. Within a week the fungus had killed the flowers in which it was sown and passed down the pedicels, the extent of its progress being accurately marked by the death of the tissues. Dissection showed that the fungus threads were for the most part passing down the pedicel just beneath the outer wall or "skin," as shown in fig. 6, and not accompanied by mycelium on the outer surface of the pedicels. The flowers and leaves on which spores were not sown were still as fresh as when gathered. The twigs were still left under the bell jar and after some days the fungus spread through the tissues of the cherry until every green part of it had been attacked and killed, and the surface covered with spores.



Fig, 6.—Oidium fructigenum growing down the pedicel of a flower: *h* threads of the fungus, *p* cells of the pedicel, *c* "skin" or outer wall of epidermis. Magnified 250 diameters. Original.

Examining the trees, which hung very full of blossoms at this time, there was no difficulty in finding dead flowers. Dissection of the pedicels disclosed the same growth of mycelium as in those of the experiment. Placing these dead flowers under a moist bell jar they gave inside of forty-eight hours the usual copious development of spores. By this time the flowers on the two or three dozen very large trees of the orchard had shed their petals; a careful examination and estimate showed that full five per cent had perished from the attack of this fungus.

By June 15 the cherries had reached full size but were yet green; some showed rot in various degrees, and a few were covered with spores. Those which were brown but with no spores, when placed in a moist bell jar over night (twelve hours) developed them in profusion.

When the cherries ripened, those touched by the dry mummied ones still clinging to the tree soon developed rot, these transmitted it to others in contact with them, and thus a whole cluster would be brought to decay. The rotting ones produced, especially if the weather was somewhat damp, a thick coat of spores. The spores, both from the freshly rotted and the mummied cherries, were dispersed by the wind over the entire crop, and led to a variable amount of rotting. The results were the most marked shortly after a light shower or mist, or during very damp days, and particularly at the point of contact of two fruits, where a drop of water was held long enough to permit the fungus to germinate and become established. There can be no doubt of the power of the germinating threads of the fungus to penetrate the uninjured skin of the fruit, at least of plums and cherries, although in experiments on peaches Peck* concluded that this was not possible; as also did Smith† who used apples, and Hallier‡ thought the fungus only entered through rifts or stomata. It seems to me these failures may have been due to neglect in putting the fruit experimented on in a sufficiently damp atmosphere. Just here lies the reason why this fungus does not annually destroy the total crop of cherries and plums, even the flowers, foliage and perhaps the trees themselves—the lack of a sufficiently and continuously moist atmosphere; my experiments certainly warrant this conclusion, and ordinary observation will to some extent confirm it, for every grower knows how much the rot is increased by moist weather and light rains after the fruit has reddened, far beyond what can be accounted for by the fungus gaining entrance through injured spots.

Although the dead and dry fruit upon the tree only has been spoken of as a source of infection, it is not the sole one, and often may not be the chief one. Fallen fruit supports the fungus to an unlimited extent, and also that in cellars and pits. An interesting estimate was made of the rapidity of spore production under favorable circumstances. A few spores (not counted) were inserted beneath the surface at a single point on each of several ripe black raspberries, which were placed under a moist bell jar in a living room. At the end of twenty-four hours a careful estimate placed the number of spores formed at each center of infection at five thousand. It took but six days to entirely clothe the berries with a close felt of spores, which of course were too numerous for computation.

One would suppose there could be no doubt of the destructiveness of this rot, and yet a curious claim has been started for it, as possessing antiseptic and fruit preserving qualities. This was first published by Von Thümen ‖, in a Vienna agricultural newspaper in 1875. His observation was that pears lying on the moist earth under the tree, well covered with Oidium, did not decay after weeks of lying there, while those free of the fungus began to decay in a few days. Under a summer apple tree also, the antiseptic influence of the fungus seemed evident, for not only were apples, which were lying in the grass and covered with the fungus, preserved for weeks, but when a portion only of the apple was affected, that part withstood decay longer than the remainder of it. Hallier has explained the matter in a fairly satisfactory way, judging by the statement of Frank * who approves of the explanation, by supposing that the fungus does not permit yeast or similar things to gain access to that part of the fruit.

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*Thirty-fourth Rep. N. Y. St. Mus. Nat. Hist., p. 35.

*Gardeners' Chronicle, XXIV, p. 52.

**Quoted by Frank, Krankh, d. Pflanzen, p. 615.

*Landw. Wochenblatt, No. 41; Fungi Pomicoli, p. 23.

Observations directly bearing on this point were made as follows: September 26, an apple still hanging to the tree was fully enveloped with the fruiting tufts of Oidium, the tissues of the apple throughout being a uniform light brown. The outside was removed to make herbarium specimens, and in twenty-four hours it was again covered with a growth of spores. The apple had a pleasant fragrance, and tasted sweet, like good dried apple. There was not the least mustiness or disagreeable quality It compressed between the fingers in the same way as moist dried apple, and pulled apart with like tenacity. Under the microscope no foreign substance but the mycelium of the Oidium could be detected, and there was a total absence of all bacteria and yeast. In the spring previous a similar observation had been made on a Rhode Island Greening apple taken from the cellar. It bore a small, brown discoloration on one side and was laid on the table to await examination. In the mean time it gradually turned brown throughout, and exhaled a very agreeable odor. After a time black specks appeared on its surface, which proved to be the spore perithecia of Sphæropsis malorum Berk., a fungus not known to have close relationship with the Oidium. The texture and qualities of the apple when cut open did not differ materially from that described above, it only being of a somewhat deeper brown color. Again no bacteria or yeast were present. In both cases the apples after being cut were exposed to the air of the room for days without decay setting in.

Without entering upon further observations, the generalization may be ventured, that in many cases the higher fungi do not of themselves produce the kind of decomposition known as rot or decay; to accomplish this they must be aided by bacteria or similar agents of fermentation. Doubtless such destructive species as the Peronosporæ of potato rot and lettuce rot, are not the direct cause of the offensive putrefaction, but it is due to the bacteria associated with them. We very properly hold the higher fungus accountable for the result, however, for it first produces by its growth those chemical products upon which the bacteria are able to thrive. The products of the bacteria in turn, which in some cases are as harmful to higher fungi as to the tissues of a flowering plant, do not in these instances check the growth of the fungus, but rather contribute to its maintenance and activity. It is a true commensalism, each promoting the welfare of the other. The inability of the usual putrefactive bacteria to overcome the resistance of the living cells, and start decay, has been well illustrated by numerous experiments performed

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*Krankheiten der Pflanzen, p. 615.

in connection with other topics, and particularly by the ineffectual inoculation of green tomatoes with bacteria, taken from a rotting fruit, in which was only bacteria and fungous mycelium*. This fact is, indeed, the safeguard of all living things against annihilation by bacteria.

Herein, it seems, lies the explanation of the preservative action of the Oidium on apples, if we can call it such: the bacteria not gaining access to the interior of the apple at the outstart, the fungus brings about changes, such as the removal of free sap and the production of sugar, and it may be other substances, which eventually prove unfavorable to bacterial development, in an analogous way to that by which the housewife forms a preserve of fruit which is not readily attacked by bacteria.

Such exclusion of bacteria from fruit attacked by fungi, cannot, from the nature of the case, be common enough to have in itself much economic importance, and we may turn at once to the more important problem of saving the fruit from the fungus and the bacteria at the same time. It is evident this could be done with fair success if keeping the fruit dry were a feasible thing, for this would prevent the germination of the spores on its surface. Some control may be exercised over the abundance of the fungus, however, by removing and burning all dead fruit remaining on the tree after the crop is harvested, which can best be done when the leaves have fallen. Whenever practicable, hogs may be kept under the trees from flowering time until the fruit is gathered, to pick up dropping fruit, which otherwise becomes the medium for the production of spores to carry the rot to the fruit on the tree. By attending to these precautions, the producer of cherries and plums, upon which this fungus is the most destructive, will save many dollars annually.

Those who desire to examine the literature of the subject must bear in mind that different authors treat of the fungus under different names, the most common of which are, beside the one given at the head of this article, Monilia fructigena Pers., Oospora fructigena Wallr. and Torula fructigena Pers. There is no well fixed vernacular name.

Disease of Clover-leaf Weevil.

Entomophthora Phytonomi Arthur.

In the latter part of May, great numbers of pale green larvæ, nearly an inch long, were found clinging to the grass and clover of the meadow, and apparently dying from the attack of some fungus. Soon after the first of June they could no longer be found. Again in October and November the same larvæ appeared abundantly on the lawn, and attended with the same fungous parasite.

The insect has been identified by Prof. J. A. Lintner, State Entomologist, as Phytonomus punctatus (Fabr.), the clover-leaf weevil. It is common in Europe, where it is not considered especially harmful. It was first definitely recorded in this country by Riley† in 1881, from Yates Co., N. Y., where it was doing much damage by feeding upon the clover plant. In 1882 it was also reported in quantity in Wayne Co., some forty miles north of the locality in Yates Co.[*] By a letter from Prof. Lintner I learn that its range is now greatly extended, being abundant in the vicinity of Buffalo, N. Y., and reported from Indiana and elsewhere. It has so far proved in general a very injurious insect,[†] although upon the grounds of the Station (this being the first year of its observance), it was not especially so, which may be accounted for by the advent of an epidemic disease that carried off the larvæ in great numbers.

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*Third An. Rep. N. Y. Agr. Exp. Station, p. 379; Amer. Nat., XIX, p. 1185.

† Amer. Nat., XV, p. 751.

The sick larvæ of all ages crawl up the herbage during the night, and instead of again concealing themselves near the ground on the approach of light, as the healthy ones do, ascend as high as possible, and if on grass, coil themselves in a horizontal position about the apex of the blade (fig. 7), or if on other objects, take a position as nearly similar as the shape of the object permits. If disturbed before the middle of the forenoon, the majority are still able to crawl, although sluggishly; by noon most of them are quite dead, but unchanged in appearance. It will be found that they cling to the leaf with greater tenacity than during life. Examining the underside of the body will disclose the fact that delicate, colorless holdfasts have grown out from the median line, which attaching themselves to the leaf, hold the insect firmly in place. Late in the afternoon, the body has changed from the normal yellowish or pea green and smooth appearance to velvety gray. The next morning there is only a small, blackened and shriveled mass remaining, while the surrounding foliage is powdered with a whitish, clinging dust, composed of the spores of the fungus. If some of the dead insects had been placed on a pane of glass, and a tumbler inverted over them during the night, they would have shrunken less, and been covered with a white fleecy growth, while on the glass, surrounding each body, would have been a white halo of spores two-thirds of an inch in diameter, such as everyone has observed about dead flies on the window in autumn. This is the general course of this rapid and fatal disease.

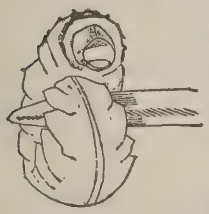

FIG. 7.

Fig. 7.—Sick larvæ of Phytonomus punctatus coiled about the tip of a blade of grass. Magnified 5 diameters. Original.

Dissecting a sick larva before death has occurred, a close net work of fungous threads will be found among the muscles which line the wall of the body. They are profusely branched, colorless, without partition walls, the contents finely granular and with or without vacuoles, or clear spots, of variable size (fig. 8). This mycelium grows rapidly and soon encroaches upon the body cavity of the insect, encompasses the various organs, finally absorbing the juices and filling up the body with a solid mass of the fungus. The mycelium does not, however, enter the tracheæ or the alimentary tract. Cutting a larva in two at this stage of the growth of the fungus, the interior will be found sufficiently firm not to collapse, with a hole at the center larger than would be made by a pin, and no juices to escape. This is not true for all cases, however, for frequently mortification due to a bacillus sets in and changes all the organs into a slate colored liquid, at the same time checking the growth of the fungus. The advent of the bacillus and the changes due to it may be dismissed as accidental.

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[*] Lintner, First An. Rep. Insects of N. Y., p. 252.

[†] Cf. Riley, Rep. U. S. Dept. Agric., 1881-2, p. 172.

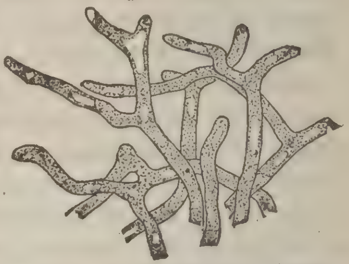

Fig. 8.—Mycelium from the interior of the larva. Magnified 150 diameters. Original.

Before the body is filled with mycelium the rhizoids or holdfasts have already been pushed out from the ventral surface of the body. These consist of branches from the mycelium, which flatten their ends firmly against the object on which the insect rests; they may grow a sixteenth of an inch in length if the supporting object is not reached sooner.

After a time great numbers of mycelial branches place themselves closely side by side, penetrate the skin of the larva, and form a solid layer, or hymenium, about the whole insect except its head. The projecting ends of the threads give the velvetry gray appearance to the surface at this stage. On the end of each branch is now formed a single oblong spore; some of the branches, however, are enlarged and sterile. The development of the sterile and fruiting branches and of the spores is shown in figure 9.

The spores are oblong, rounded at both ends, one-celled, with thin walls and colorless, granular contents, and are comparatively large.* This is their appearance when fresh (fig. 10 M); spores from a dry specimen five months old, mounted in water for examination, presented a clear spot at the center, and had one end somewhat pointed (fig. 10 N). The spores germinate in water by pushing out one or several vegetative threads (fig. 10 A), which grow tortuously to many times the length

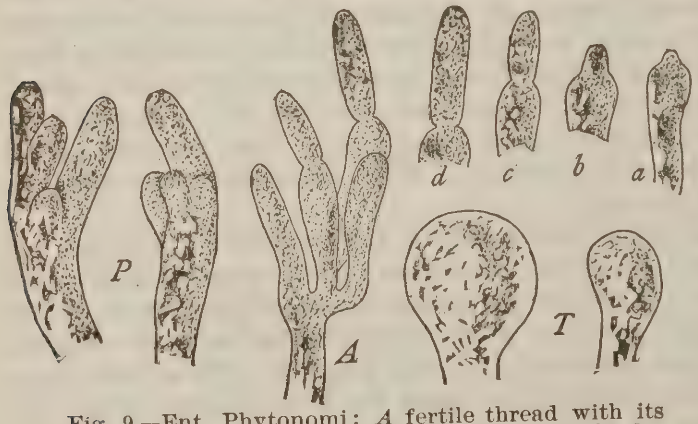

Fig. 9.—Ent. Phytonomi: *A* fertile thread with its branches and spores, *a b c d* successive stages in the development of the spore; *P* two young fertile threads; *T* ends of sterile threads. Magnified 430 diameters. Original.

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*The technical description of this fungus with measurements appears in the Bot. Gazette for January, 1886.

of the spore. These are summer or temporary spores, i. e. they retain their vitality for only a short period. In several trials, spores which had lain upon glass in the room for five days, almost entirely failed to germinate. Probably out of doors they would last a little longer. The similar spores of the fly fungus are said to retain their germinative power for two weeks.

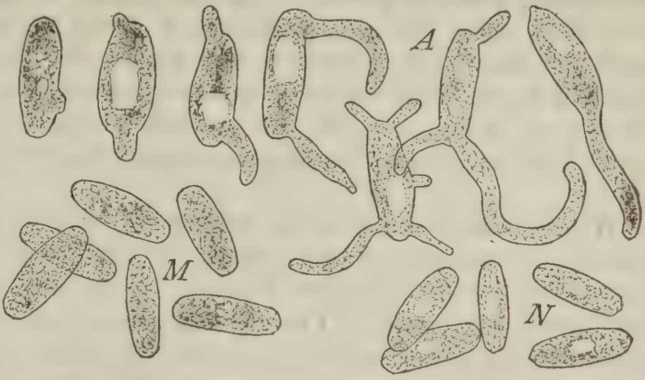

Fig. 10.—Spores of Ent. Phytonomi: M six fresh spores; N five spores from a dried specimen; A various stages of germination. Magnified 430 diameters. Original.

Fungi of this kind form resting spores inside the body of the insect, generally forming a light colored pulverulent mass. Resting spores of the fly fungus (E. Muscæ) are very rare; in a species infesting locusts* found in Iowa and Nebraska (E. Calopteni Bes.), only the resting spore stage is known. Thus of most of the species so far recorded only one or the other stage is commonly met with. Different species of this genus are found upon the cricket, cicada, mosquito, cut-worm, plant lice and cabbage worm.† That on the cabbage worm, E. sphærosperma Fres., is much the most closely related to E. Phytonomi. It was first found in Germany in 1856,‡ with only resting spores; in 1869, the other stage of development was found by Brefeld, who named it E. radicans from the notable holdfasts. He did not meet with the fungus again till 1875. He now cultivated it through a number of series, using a hundred and twenty healthy worms for each. These worms were infected by placing the summer spores upon them. Of the first series eighty-one took the disease, the others were killed by insect parasites or lost by changing to pupæ. Sixty-two of the eighty-one died in a week with their bodies luxuriantly covered with spores, the other nineteen showed few or no spores, lived much longer, and finally dried up into mummies. Upon opening them they were found filled with a pulverulent mass of yellowish white spores—the resting spores. In the second series fifty produced summer spores, twenty-nine resting spores, and the remainder were lost. In the third series nine gave summer spores and thirty-eight resting spores; in the fourth twenty-nine gave summer spores and fifty-four resting spores. The constantly increasing number of those producing resting spores ran parallel with observations out of doors, and the author is inclined to believe that earlier in the season (first of September) only summer spores are produced, and that finally there are only resting spores.§ Although E. Phytonomi was observed till November 20, when cold weather set in, no mummied larvæ were found and no resting spores; no cultivations were made.

The failure to discover the resting spores does not augur well for its re-appearance next year, although it is to the interest both of the cultivator and the scientist that it should be abundant. The former will thus have his meadows saved from the ravages of the weevil, and the latter can complete the study of the development and habits of a more than usually interesting fungus. It would, in fact, be a good thing for cabbage growers to have the cabbage worm fungus imported from Germany to accompany that insect and keep it in check.

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*Amer. Nat., 1883, p. 1280.

†Cf. Winter, Krypt. Fl. v. Deutschl., I, p. 74.

‡Berl. Botan. Zeit., 1856, p. 883.

§Schimmelpilze, IV, p. 100.

Where this fungus came from, it being a species heretofore unrecorded, is useless to conjecture. Although it is found on a newly imported insect, it is not known in the country from which the insect probably came. That it may be a condition of the salmon disease, or other water fungi, is not probable, as it is now generally accepted that the supposed close relationship between the Entomophthoræ, of which our fungus is one, and the Saprolegniæ or water molds belongs, as DeBary* says, "to the history of errors."

The effective manner of the distribution of the spores is interesting. The insect climbs as high as possible, and is fastened to the object by holdfasts provided by the fungus, so the body may not fall off when dead. Locusts, attacked by the fungus already mentioned, act in the same manner, but are held in place by their legs and claws simply.† The spores when mature are projected to some distance from the body of the insect, its elevation aiding in the distribution. They are discharged in the night when the healthy larvæ are feeding and most exposed, not being concealed beneath foliage as in the daytime. The spores stick to any object they touch, and if a larva is hit the spores remain attached to it. And lastly, it being night time, there is more probability of the requisite amount of moisture being present to insure germination. Taken as a whole it is an admirable device to accomplish the speedy and effective distribution of short lived spores.

WEEDS AND THEIR FUNGOUS PARASITES.

The desirability of keeping cultivated ground free of weeds is generally acknowledged, as well as the advantage secured by clearing all waste corners and spots to prevent re-seeding, as far as possible. The abstract propositions are not likely to be disputed, but in practice they need to be enforced by numerous illustrative arguments. An observation touching upon this matter was undertaken in the following manner: A strip of land from an old pasture was ploughed in spring to afford additional garden room. It was laid out into plats of one-twentieth of an acre each, one of which about the middle of the strip was permitted to lie untouched. It of course sprang up to weeds, although being the first ploughing, after so long a lapse of time, their appearance was at first rather slow. For some reason, not obvious, the north half soon eclipsed the remainder in the quantity and luxuriance of its vegetation, among which the Canada thistle was most conspicuous. The soil and weeds remained undisturbed till July 15, when the Canada thistles and the largest of the other weeds were removed from the north half, counted and destroyed. The result is given in the annexed table. The ground on the south half was still partly bare and the weeds were mostly small, so it was

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*Morph. u. Biol. d. Pilze, p. 172. †Osborn, Amer. Nat., 1883, p. 1286.

WEEDS GROWING ON ONE-TWENTIETH OF AN ACRE DURING 1885.

ENGLISH NAME.	LATIN NAME.	July 15. North Half.	Oct. 13. North Half.	Oct. 13. South Half.	Total.
Three-seeded Mercury	Acalypha Virginica L.		2		2
Virginian Anemone	Anemone Virginiana L.		1		1
Redroot	Amarantus retroflexus L.		1	3	4
Ragweed	Ambrosia artemisiæfolia L.		14	48	62
Ragweed	Ambrosia trifida L.	68			68
Burdock	Arctium Lappa L.			1	1
Milkweed	Asclepias Cornuti Dec.	16	8	43	67
New England Aster	Aster Novæ-Angliæ L.		2	1	3
Shepherd's Purse	Capsella Bursa-pastoris M.			2	2
Pigweed	Chenopodium album L.	10	9	2	21
Ox-eye Daisy	Chrysanthemum Leucanthemum L.			3	3
Canada Thistle	Cnicus arvensis Hoffm.	2050	2060	270	4380
Common Thistle	Cnicus lanceolatus Hoffm		3		3
Spurge	Euphorbia maculata L.	34	7	28	69
St. John's-wort	Hypericum mutilum L.			1	1
Wild Lettuce	Lactuca Canadensis L.			1	1
Catnip	Nepeta Cataria L.		1	1	2
Wood Sorrel	Oxalis corniculata L., var.	49	12	1	62
Witch Grass	Panicum capillare L.		61	62	123
Barn-yard Grass	Panicum Crus-galli L.		10	1	11
Low Finger-grass	Panicum glabrum Gaud.		135	381	516
Common Parsnip	Pastinaca sativa L.			3	3
Timothy	Phleum pratense L.	24	3		27
English Plantain	Plantago lanceolata L.	26	9	127	162
Common Plantain	Plantago major L.		10		10
Common Plantain	Plantago Rugelii Dec.		1		1
Kentucky Blue-grass	Poa pratensis L.		182	12	194
Smartweed	Polygonum acre H. B. K.		7	7	14
Knotgrass	Polygonum aviculare L.	7			7
Black Bindweed	Polygonum Convolvulus L.	12			12
Smartweed	Polygonum Pennsylvanica L.		2		2
Lady's Thumb	Polygonum Persicaria L.	117	3		120
Smooth Sumach	Rhus glabra L.			1	1
Red Raspberry	Rubus strigosus Mx.		5		5
Sheep Sorrel	Rumex Acetosella L.		20		20
Curled Dock	Rumex crispus L.		3		3
Red Dock	Rumex sanguineus L.		14		14
Foxtail Grass	Setaria glauca Beauv.	4	1359	870	2233
Pigeon Grass	Setaria viridis Beauv.	420			420
Golden Rod	Solidago Canadensis L.		1	3	4
Sow Thistle	Sonchus oleraceus L.		1		1
Dandelion	Taraxacum officinale W.		100	29	129
Red Clover	Trifolium pratense L.		3	1	4
Yellow Clover	Trifolium procumbens L.			1	1
White Clover	Trifolium repens L.		16	21	37
		2837	4065	1924	8726

left untouched. At the close of the season, on Oct. 13, the whole plat was cleared, and the individual plants of each kind counted. The table shows the result. At the time of the first counting the pigeon grass had mostly headed, while the foxtail grass, which so much resembles it as not to be readily distinguished by the common field laborer, was still small. At the last counting there was little of the former present, and on account of the difficulty of separation it was all counted in as foxtail.

By looking at the totals it will be seen that nearly nine thousand individual weeds grew on this small piece of ground during the season. As the majority of these were enabled to reach an ample development, the number of seeds produced, when estimated by the tables given by Lazenby,* Sturtevant† and other observers, is so enormous as to form a sufficiently startling commentary on tolerating weeds in waste corners. But half of this number was Canada thistles—if we subtract these the totals will stand as follows:

	All weeds.		Can. thistles.		Other weeds
Oct., north half	4065	—	2060	=	2005
Oct., south half	1924	—	270	=	1654
Oct.	5989	—	2330	=	3659
July	2837	—	2050	=	787
Total	8826	—	4380	=	4446

A striking indication of the commonness of the plants of this list is the fact that three fourths of the forty-five species enumerated bear the names given them by Linnæus, the "father of botany," and part of the others were originally named by him, the names having been changed since. It is a somewhat different list, however, from what one would obtain on ground kept under the plow for a number of years. Such plants as three-seeded mercury, anemone, aster, St. John's-wort, sumach, raspberry, golden-rod and the clovers are not usually counted among the weeds of hoed ground, while such universal and noxious weeds as purslane, May-weed, chick-weed, mustard, pepper-grass, carpet-weed, cockle-bur, etc. are conspicuously absent. In the usual garden soil there would undoubtedly have been more individuals, making it necessary to count and remove the larger ones several times during the season, in order to give all a fair chance to grow. The observation, in fact, very well represents the luxuriance and kind of vegetation of the borders of fields, hedgerows, neglected corners and similar adjuncts of cultivated ground, which too often are permitted to go undisturbed, unless to be mown in autumn because of their unsightliness, and in this connection it conveys an admonition of no uncertain note.

The help from parasitic fungi, which the cultivator receives in keeping weeds in check, is not as a usual thing well recognized, and yet is worthy of attention. It is rare that any of these parasites are sufficiently aggressive to exterminate a weed even in a limited locality, but they do much to weaken the growth and keep them in check. The Canada thistle rust, mentioned in the last report of the Station,* usually prevents the formation of seeds, and permits the plant to make but a feeble growth. Some seasons at least its activity must be an item of considerable moment, and as it is not known to inhabit other plants in this country, it is to be encouraged. A less effective parasite of the same plant is the white rust (Cystopus cubicus Lév.), which forms white blister-like patches on leaves and stems, of irregular shape but usually elongated, and an eighth of an inch or more long. It is not confined to the thistle as in the case of the dark rust, but attacks several related plants such as the rag weed and wild wormwood. It was also found this season in unpleasant abundance on our beds of salsify, giving the foliage quite a spotted and whitened appearance. A surface mildew (Erysiphe lamprocarpa) makes a white cobwebby mould over several kinds of thistles, cocklebur, various stick-tights and other noxious weeds.

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*Third An. Rep. Ohio Agr. Exper. Station, p. 158.

†First An. Rep. N. Y. Agric. Exper. Station, p. 86.

Another one of the white rusts (C. Portulacæ Lév.) is confined to the purslane, and the cultivator should look upon its white mottling with the reflection that even this audacious and over corpulent plant has its natural enemies.

The pigweed, the one whose tender foliage is sometimes eaten for greens, is beset by a number of fungous enemies, which spot and riddle its leaves, besides a Peronospora (P. effusa Rabh.) which often takes enough of its nourishment to considerably enfeeble the plant. This Peronospora does not induce rot as in the case of the nearly related forms on lettuce and potato, but builds patches of dirty white felt on the underside of the leaves on which the spores are produced.

The redroot, which also takes the name of pigweed in many localities, has a white rust of its own, and is also infested with various microscopic fungi which taken together result in no slight drain upon its forces. And so we might continue through the whole list of weeds, each would be found to be beset by its natural enemies, which in many cases are confined to them alone, or only spread to plants which are not especially prized by the cultivator. It is evidently well to bear in mind that the parasitic fungi are not all bad, but that some are even beneficial by preying upon troublesome plants and insects; recognition of one's friends is also a desirable thing, and hence the wisdom of giving some attention to the identification of such parasites and to their habits of life.

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*Third An. Report, p. 385.

* Report of the Chemist.

The work in the chemical department of the Station for the past year has been similar in its nature to that of the two preceding years, having been largely devoted to the examination of foods and milk in connection with the several feeding experiments. (See report on feeding experiments by the director). Owing to the assistance of a chemist in the laboratory, many more determinations have been made, and time has been found for some investigations upon the properties of milk and upon the artificial digestion of fodders (see report of assistant chemist on this subject). Daily observations have also been made upon the amount of sunshine received at the Station. A detailed account of the analytical work accomplished is submitted.

MILK.—300 partial examinations that have included determinations of specific gravity, solids and fat, and the determination of the specific gravity in nearly 400 other samples; also 225 churnings in duplicate.

BUTTER.—9 analyses.

FODDER.—60 complete analyses and 50 determinations of albuminoids and their digestion in different samples of feed.

WATER.—Monthly examination of the drainage water from each of the three lysimeters, and frequent examinations of water from the drains through the experiment plats; 8 examinations of waters for private parties.

SORGHUM.—3 examinations for sugar,

Besides the above there is in progress at the date when this report is presented (Dec. 1), several fodder analyses, and about 20 analyses of butter.

A STUDY OF THE FAT GLOBULES OF MILK.

When milk is examined with a sufficient magnifying power, it appears as a colorless liquid, in which are suspended an immense number of transparent globules, having a high refractive power, which gives them their characteristic appearance of bright objects with dark margins. The structure of these globules, which constitute the fatty portion of the milk, has been the subject of considerable controversy. By some they are supposed to be surrounded by a thin membrane, and are therefore cells filled with fat. Others consider them as particles of free fat, in the form of an emulsion, with the serum of the milk. Others still contend that the albuminous matter of the milk is attracted and in some way condensed upon their surface, forming what is called a *haptogenic* membrane.

Before considering the evidence in favor of either of these hypotheses, it is necessary to examine briefly the nature of emulsions and the conditions under which they exist. The term emulsion is usually applied to mixtures of oils with other liquids, as water, for which they have no natural affinity. These mixtures are prepared by means of a third substance, which is soluble in the aqueous portion, and gives it a certain viscosity. For this purpose saccharine, mucilagenous, or soapy matters are usually employed. Any substance, however, that renders a liquid capable of forming bubbles when shaken with air, that remain for some time without breaking, is a suitable agent for this purpose. The emulsion is formed by triturating or vigorously stirring the substances together, by which means the oil is broken into small particles, which do not readily unite with each other, being separated by a thin film of liquid analogous to that which separates the bubbles of air in foam or soap suds.

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*S. M. Babcock, Ph. D.

It is essential in the preparation of emulsions that all of the ingredients be in a fluid condition, as they are then more easily divided, and assume a spherical form, which is more conducive to the permanence of the mixture than are the irregular forms which occur when solids are taken.

A true emulsion, when once formed, may be diluted to a large extent without destroying its properties, but afterwards if allowed to stand for a sufficient time, the fatty portion will separate, forming a layer, which, however, is still an emulsion and not free fat, the globules being separated from each other by a film of liquid, and may be again diffused throughout the whole volume by gentle shaking. Alcohol and acids are quite incompatible with the formation or permanence of emulsions.

The analogies which exist between artificial emulsions, prepared as above, and milk are numerous, and in many cases quite obvious. Some of these which bear upon the structure of the globules will be reviewed.

1. The microscopic appearance of the fat globules is identical in the two. The only notable difference being the greater variation in the size of theglobules in the artificial emulsion. The sharp refractive rings which surround the globules of milk, and which have often been mistaken for a membrane by the unskilled, are equally sharp in an artificial emulsion of the same fats.

2. The separation, on standing, of the globules as cream, in which they retain their form and microscopic appearance. This is promoted in milk and in artificial emulsions alike, by dilution with water, whereby the suspending liquid is rendered less viscous, and permits the globules to move more freely.

3. Effect of churning. It is well known that by sufficient agitation, at the proper temperature, the globules of milk become united into granules, and finally, by continuing the operation, into larger masses that constitute butter. The temperature at which cream may be churned with satisfactory results has a narrow range (56°-70° F.); below 50° F. or above 80° very little butter can be obtained, and that is usually of poor quality; below 40° and above the melting point of the butter fats (90° to 100°) no amount of churning will produce butter. All of this is equally true of artificial emulsions

made from the butter fats. Below 40° the particles of fat are so hard that they do not readily adhere to each other when brought in contact, so that they retain their original size, but may become somewhat distorted and angular from the blows received. Above the melting point of the fat in any emulsion, the globules become more and more divided by agitation, so that they are continually going farther and farther from the state of butter, but in this case the globules always retain their spherical form. The following experiment shows that milk behaves in the same way.

The number of globules in a sample of new milk was determined and found to be 159 in .0001 cubic millimeter. This milk was then thoroughly stirred with an egg beater for several minutes, it being kept at 100° F, or several degrees above the melting point of its fat. The number of globules was then determined again and found to be 174 in the same volume. The stirring was repeated twice more under the same circumstances as before, the globules after each churning being respectively 231 and 283 in .0001 cubic millimeter.

Another experiment of the same nature as the above, but in which the number of globules whose diameters were greater than one division of the micrometer scale (.0024 millimeter), was also determined, gave the following results:

The total number of globules in .0001 cubic millimeter of the milk was found to be 284, and the number in the same volume having diameters above .0024 millimeter, 136. After churning for several minutes at 100° F. there were found 350 globules in .0001 c.mm. and of these only 125 had diameters above .0024 mm., showing clearly that the number of small globules had been increased, and the larger ones diminished.

The microscopical examination of the milk in both of these experiments, before and after the several churnings, showed no difference in the appearance of the globules except that the number of small ones was largely increased. The globules were not distorted in the least, nor were any broken membranes discovered, although in the first case the number of globules had been nearly doubled by the churning.

4. Action of ether. Probably the argument most often advanced in favor of a membrane has been that ether shaken up with milk fails to remove the fat, unless a little alkali or dilute acid be added, the reason assigned being that the membrane enclosing the fat prevents the ether from coming in contact with it, but that this membrane is dissolved by the alkali or acid and the fat set free. This is decidedly a misinterpretation of the fact, which could scarcely have been made by one who had tried the experiment, for while it is true that ether thoroughly incorporated with milk by shaking does not remove the fat, it is no less true that the ether itself is not separated but remains incorporated with the milk as an emulsion, and there is evidence that it is in combination with the fat. For while the butter globules of milk as seen in the microscope are highly refractive and have the peculiar appearance described before, the drops of this emulsion are nearly colorless, and in refractive power differ little from the surrounding liquid, none of them having the characteristic appearance of the fat globules of milk. Besides arti-

ficial emulsions behave in the same way when treated with ether, and in this case there can certainly be no membrane to protect the fat. If the effect of the addition of a little alkali or acid is due to the solution of a membrane, why should alcohol, which hardens all tissues, certainly does not dissolve them, act in the same way. The fact is that any substance that destroys the emulsion will have the same effect. If in the preparation of an emulsion, a highly colored oil, such as compose the prepared butter colors, is used instead of a colorless one, and the emulsion when formed shaken with ether, the globules of the mixture produced will appear under the microscope more or less colored, according to the amount of ether taken, showing that the colored fat has been dissolved in the ether.

Not only have milk and artificial emulsions behaved alike in respect to the points mentioned above, but the resemblance has been equally marked in all others to which our experiments have been directed, so that the conclusion seems inevitable that milk itself is an emulsion. But there are a few observers who think they have seen these membranes, and to them the evidence which these analogies present is inconclusive. While acknowledging the greater weight which direct vision should have, still, in consideration of the uncertainty which always attends such observations, and the failure of others skilled in the use of the microscope to confirm them, coupled with the fact that under the most favorable circumstances the number seen has been very small compared to the immense number of globules which must have been present, it seems probable that some abnormal appearance, or foreign matter in the milk has been seen and, through the influence of a preconceived opinion, supposed to be the broken sacks which had contained the fat.

This subject has been treated at considerable length because it has a practical bearing upon the butter industry. If it is true that milk is an emulsion, or even in most of its properties behaves like one, we have a ready means, in artificial emulsions, of testing certain questions which with a complex substance like milk are difficult or even impossible of solution. It also modifies to a certain extent our ideas concerning the best methods of churning, and helps to explain why some give better results than others. Experience has done much toward determining the best methods, and has brought about many changes which have had a marked influence on the quantity and quality of the product. But these changes, as shown in the development of the churn, have been steadily in a direction which the supposition that milk is an emulsion would demand. A few years ago most of the new churns put upon the market consisted of complex arrangements of floats for the purpose of beating and agitating the cream in the most violent manner possible. Now however the churns used by the most successful manufacturers contain no floats, and even have the angles modified so that rubbing or grinding of the globules except upon each other is reduced to a minimum.

The former churn is precisely what is required to rupture the membranes, if they exist, and set the fat free; but is not consistent with the idea of an emulsion. Have the dairymen made a mistake in the quite general adoption of the simpler churn? I think not, and trust that experiments about to be made will furnish information which when applied to methods will still further improve the quality of the butter made.

It may not be out of place here to state in a general way some of the properties of butter which distinguish it from cream. Butter consists essentially of the fatty portions of milk which have coalesced during the process of churning, and have entangled with it some of the casein and other matters which the cream contains, so that the chemical composition of the two varies only in the relative amount of the different ingredients. In extreme cases they may be almost identical so far as their chemical composition is concerned, and yet no one would be likely to mistake the one for the other, their physical composition being very different. In cream the fat globules are all separate, a thin film of serum preventing them coming in actual contact; in butter these films are broken, the fat of the adjoining globules being in contact and adhering. Cream is an emulsion, butter a mass of fat retaining in its structure a portion of serum or other emulsifying liquid. Cream, with care, may be diluted indefinitely with water, the globules of fat becoming uniformly distributed throughout its volume. Butter on the other hand when placed in water will retain its form and in no way be affected unless the agitation is violent and in no case will it have the character of an emulsion.

There have within the last few years been quite a number of measurements made of the size of the fat globules in milk from different animals and from different breeds. While there is no reason for doubting the conclusions derived from these measurements, viz.: that the size of globules varies largely in the milk from different breeds, the largest globules being associated with those noted for butter; and further that large globules are, in general, associated with facility of separation of cream and ease and economy of churning, still the methods, by which the results have been interpreted might lead to serious error, in so far as the size of the globules in the different cases have been taken proportional to thier average diameter as obtained from a number of micrometer measurements. This would be sufficiently accurate for most purposes if the globules were nearly uniform in size. But as the volumes of spheres vary not directly as their diameters, but as the cubes of their diameters, and as the average of a series of numbers does not determine what the average of their cubes will be, it follows with bodies varying to the extent often occurring in the fat globules of milk that their average diameter conveys no definite idea of their volume, which is really in most cases what is sought. An example will make this clear. If we have three spheres whose average diameter is 2, their individual diameters may be 2, 2, 2 or 1, 2, 3 or 1, 1, 4 in which cases their average volumes would be as 8 : 12 : 22 respectively.

The average volume of milk globules, owing to their variable size, is always greater than the volume indicated by their average diameter, the difference between two volumes being greatest when the globules vary most in size. It is therefore evident that if we wish to study the influence of size of globule upon the character of milk, their volume rather than their average diameter should be considered. The volume of milk globules may be dedetermined directly from their individual diameters or their average volume may be found by dividing the volume of fat, obtained by analysis, in a given amount of milk by the number of globules which it contains. The first method requires so many accurate measurements and extended calculations that it is really impracticable. The latter demands an estimation of the fat and number of globules, but as nearly all investigations upon milk requires a determination of the fat the counting of the globules is usually the only extra labor. The ordinary method of mounting liquids for microscopic examination, by placing a drop upon a glass slide and laying a thin cover glass upon it, cannot be used for this purpose, it being practically impossible to determine the volume of milk in a given field with sufficient accuracy.

This difficulty may however be overcome by confining the milk to be examined within a space all of whose dimensions are known or easily determined. For this purpose a small capillary tube about one tenth millimeter in diameter is well adapted.

This tube may be drawn from about ¼ inch tubing which should be round and have the sides of uniform thickness. It should be heated quite hot and drawn as nearly as possible in the direction of its length, so that the resulting capillary tube will be of uniform diameter, and round, not flat. This is very essential, as any flatness in the tube used will greatly exaggerate the results. A flat tube can usually be detected by rolling between the fingers, but it is safer to measure its diameter in two or three positions with the microscope. The tube should be drawn straight, as a curved one is never quite round. With some one to assist, several feet may be drawn at once and, if successful, supply material for many determinations.

The milk for examination must be largely diluted before it is placed in the tube, otherwise the globules will be so numerous and overlap each other to such an extent that it will be impossible to count them. For ordinary fresh milk a dilution to fifty times its volume (10 c. c. to 500 c. c.) is about right. There are however some milks in which the globules are very numerous and very small where a greater dilution is desirable. Skim-milk should be diluted very much less, ranging from ten to twenty times its volume according as the separation of cream has been more or less complete.

For mounting a sample of this diluted milk a capillary tube from 2 to 3 centimeters long is taken and one end immersed in the liquid, when it fills immediately by capillary attraction. Both ends are then closed with a little soft wax or vaseline to prevent evaporation and movement of liquid in the tube. Two or three tubes thus filled and sealed are laid upon a glass slide. A drop of glycerine is placed upon them and then over all a thin cover glass. After standing a short time in a level position they are ready for examination. It is best to place the slide immediately upon the stage of the microscope, which should be so arranged as to be level. Owing to their low specific gravity, the globules will presently take a position along the upper side of the tube, where they may be readily brought into focus and easily counted. Although it is best to count the globules as soon as possible after mounting, it may be deferred, if the tubes have been properly sealed and kept in a level position, for several hours, or even days, without materially affecting the number found.

By means of an eye piece micrometer the internal diameter of the tube is carefully measured and then turning the eye piece so that the scale is lengthwise of the tube all of the globules included in a certain number of divisions are counted. The slide is then moved along until a new field appears and another count is made. This is repeated till five or six observations have been made with each tube, this being usually sufficient. If the tube has been carefully selected there is no need of making more than one measurement of its diameter, as it will be sufficiently uniform throughout the length used to make no appreciable difference. In a tube .1 millimeter in diameter the number of globules which will be found in a length of .1 millimeter will range, with milk diluted to 50 times its volume, from 50 to 100.

This operation is usually repeated with two or three tubes containing the same milk and the results calculated for a tube of uniform diameter and length, so that they may be directly compared. To facilitate calculations the standard diameter of the tube is taken as 100 divisions of the micrometer and the length as 50 divisions, this being the length of the field that has been included in one observation. The number of globules in a tube of this length and diameter of 100 divisions, is found by the formula $\frac{10000\, n}{d^2}$ in which n is the number of globules found in the standard length of tube, and d is the measured diameter of the tube. The numbers thus found are sufficient for the comparison of any two milks, but in order to make them of general application the numbers should represent the globules in some definite volume of undiluted milk. They can be reduced to this standard by multiplying them by a constant number which combines the ratio between the volume of the above tube and the volume desired, and also the dilution of the milk. The figures given in this report are calculated for .0001 cubic millimeter of milk, this being a convenient unit and one which does not give numbers too large to be comprehended.

It may be interesting to the curious to know that ten ciphers added to the number of globules in .0001 cubic millimeter, will give the number in one litre or approximately one quart of milk.

The average volume of the globules may be obtained by dividing the volume of fat, as derived from analysis, in .0001 cubic millimeter of milk by the number of globules which it contains. But as relative values only are of use, it is sufficient to divide the per cent. of fat by the number of globules. The relative volumes in this report have deen derived in this way, but, to avoid a long decimal, the numbers given have been multiplied by 10,000. To be strictly accurate the specific gravity of the milk and the butter fats should be considered, but as this would scarcely change the relation of the figures, it is omitted. With this modification the numbers given represent in absolute volume ten billionths of a cubic millimeter.

An example that has occurred in actual practice is presented in order to illustrate the methods used and to indicate how great variation may be expected in duplicate determinations. It has been selected on account of the wide difference in the diameter of the tubes used, and is in no respect better than may be expected if due care is taken in the selection and measurement of the tubes, and in the thorough mixing of the diluted milk. Rarely have differences of ten per cent. occurred in duplicate determinations, and the general results have not, as a rule, been more than three or four per cent. apart. The number of globules represents the number counted in each field, the length of which in each case is 50 divisions of the micrometer scale.

	No. 1	No. 2	No. 3
Diameter of tube in div. of micrometer scale	48	72	60
	No. of globules.	No. of globules.	No. of globules.
	28	55	31
	37	69	48
	21	70	48
	34	56	46
	37	73	49
	31	67	56
Average	31	65	46

Applying the formula $\frac{10000\ n}{d^2}$ to these averages and we have for reduction to standard diameter of 100 divisions by substituting the values above for

Tube No. 1	$n=31$	$d=48$	$\frac{310000}{2304}$	$=$ 134
Tube No. 2	$n=65$	$d=72$	$\frac{650000}{5184}$	$=$ 125
Tube No. 3	$n=46$	$d=60$	$\frac{460000}{3600}$	$=$ 128
Average for the three tubes				129

This gives the number of globules in a tube whose diameter in division of the micrometer scale is 100 and whose length is 50. Each division of the micrometer in the instrument used equals .0024 millimeters. It follows that the capacity of this tube is .005425 cubic millimeters, and as the milk in this case was diluted to 50 times its volume this represents .0001085 cubic millimeters of milk. The number of globules in .0001 cubic millimeter of milk can, therefore, be found by dividing the number obtained above by 1.085, or by multiplying by .92. This gives 119.

The relative size of the globules is found by dividing the per cent. of fat by the number of globules in .0001 cubic millimeter of milk, and, to avoid fractions, multiplying the result by 10000. The per cent. of fat in the milk taken for this example was 4.14. This gives for the relative size $\frac{4.14 \times 10000}{119} = 348$.

The determinations thus far made have shown a marked difference in cows, both in the number and size of globules which their milk contains, and this difference can by no means be attributed to the breed alone; as, with the exception of the native cows, Ceres and Juno, all animals whose milk has been examined have been Jerseys. This is evident from the table below, in which appear the averages obtained from the milk of each animal tested.

Name of Cow.	Breed.	No. of examinations.	No. of globules in 0001 c. mm.	Relative size of globules.	Melting point of butter-fat.	Skimmed Milk. No. of examinations	Skimmed Milk. No. of globules in 0001 c. mm.	Skimmed Milk. Relative size of globules.
Jem	Jersey	41	147	344	F 95	22	32	--
Emm	"	4	105	677	--	--	--	--
Ann	"	3	233	220	--	--	--	--
Meg	"	3	367	156	88	--	--	--
*Hilda D.	"	4	127	459	96	1	4	227
*Evelina of Verna	"	4	158	383	93	2	6	158
*Edessa	"	3	271	184	89	--	--	--
*Carlos Maud	"	1	215	187	--	--	--	--
*Countess of Verna	"	1	158	318	95	--	--	--
Ceres	Native	6	201	172	--	2	89	--
Juno	"	6	285	140	--	1	50	--
Mares Milk	------	1	47	100	--	--	--	--

* Property of F. Bronson, Southport, Conn.

This investigation has not yet been continued long enough nor have the determinations been made with sufficient regularity with any one cow to indicate what effect the ration, the time from calving, age of the cow, etc., may have, but there is evidence that very slight changes in the condition of the animal are quickly shown in changes of the globules. This has been more noticeable in respect to their number than their size, as is shown in Jem's milk in March and April last, during which time 14 examinations were made of the morning's milk and 16 of the evening. The average for these were :

	Number in .0001 cubic millimeter.	Relative size.
Morning	123	358
Evening	157	351

At the times when the above determinations were made, Jem was milked after 7 A. M. and about 5 P. M., no strict regularity being observed, so that the day interval between milkings was much less than the night interval, the former varying from 9 to 10 hours and the latter from 14 to 15 hours. Below are given results obtained from May 18--27 inclusive. Until the morning of May 22, she was milked as in the other experiments, but afterwards she was milked regularly at 6 A. M. and P. M., the intervals all being 12 hours. She was also kept in a darkened stable, with disturbing influences removed so far as possible. These results show in a marked manner the effect of irregularity in milking, and may, perhaps, explain some of the apparent discrepancies in other determinations.

Date.	Number of globules in .0001 cubic millimeter.	Relative size.
May 18, evening	171	239
May 19, morning	144	268
May 21, morning	124	357
May 22, evening	151	296
May 23, morning	150	305
May 25, morning	151	297
May 25, evening	148	304
May 27, morning	149	306
May 27, evening	148	307

With the exception of Emm, the globules of whose milk have always been very large, the numbers representing the relative size of the globules, represent quite closely, so far as the cows have been tested, their relative value for butter production. The cows, Hilda D, Evelina of Verna, and Edessa, gave in an official test 21 lbs. 2 ozs., 19 lbs. 10 ozs. and 10 lbs. 6 ozs. of butter, respectively, in 7 days. (See Jersey tests in this report.) Jem has made 15 lbs. of butter in seven days. So far as the cows of the Station herd have been tested, the native cow, Ceres, stands next to Jem in per cent. of fat recovered in her butter; then comes Meg, and last of all, Juno. The cows, Emm and Ann, have not received sufficient test to indicate their standing.

There seems also to be some relation between the melting points of the butter fats and the size of the globules (see table above), and although these are not directly proportional they are sufficiently marked to indicate some dependence upon each other.

An inspection of results obtained with Juno and Ceres during the feeding experiments also show decided changes which may and may not be due to the ration. All discussion of this question has been intentionally postponed until further and more conclusive data are obtained.

BUTTER TESTS.

The butter tests of the past year have, with the exception of a short test of the Jersey cow, Jem, been made with the native cows, Ceres and Juno. The tests were supplementary to the feeding experiments with starch refuse and glucose meal, and the results obtained will be found in the report of the director on these foods. There are, however, some relations shown by the tests that are independent of the foods, and which may properly be discussed here.

The trials were all made with the Cherry test churn described in the report of this Station for 1884. The quantity of milk taken was in every instance 400 grams (about a pint); this was set in glass stoppered quart bottles in a tank through which water from the spring was running constantly. The temperature of this water varied from about 50 F. at the beginning of the experiments in December to 40 F. in Feb. and March. The time set was usually 54 hours, but in a few cases was only 30, and in a few more was extended to 80. The best results were obtained when the milk was from 48 to 60 hours old. Before churning, the bottles were removed from the water and placed upon a table in a warm room for several hours, and, when ready to churn, the temperature was adjusted by placing the bottles in warm or cold water, as appeared necessary. The temperature of churning varied considerably, sometimes being as low as 60 F. At other times it was necessary to heat the milk nearly to 80 before butter could be obtained. In all cases it was intended to conduct the churning at as low a temperature as possible. The temperature of churning was very difficult to regulate, as the temperature of the room in which the churn was placed could not be controlled, and not only varied from day to day, but often changed several degrees while the churning was being done. The small quantity of milk taken was quite sensitive to these changes, so that it was often impossible to maintain any given temperature throughout.

The time of churning ranged from 15 minutes to several hours, and in a few instances no butter was obtained after a whole days churning. The churning was considered finished when the butter had separated in grains about the size of wheat kernels. It was removed from the bottle in this condition and washed with cold water till all buttermilk was removed. The water was allowed to drain off with little working, when it was weighed, and after standing in a dry and warm place for 24 hours, was weighed again. It is from these last weighings that the percentages of butter given are obtained.

All churnings have been made in duplicate, the results being very satisfactory, as the variation has rarely exceeded .2 per cent. This is no greater than usually occurs when large quantities of milk are taken, while the small quantity required in this method makes it much preferable when many different milks are to be examined.

If we number the churnings in the order in which they were made, and then, retaining these numbers, arrange them according to the per cent. of fat in the milk, we have the table below.

CERES.

No. of churning.	Per ct. of fat.	Per ct. of butter.	Per ct. relation of butter to fat
18	3.08	3.73	120.7
77	3.11	2.86	91.9
65	3.23	0	0
75	3.25	2.40	73.8
51	3.26	3.23	98.5
79	3.27	2.68	82.1
55	3.28	3.23	98.3
25	3.29	3.12	94.8
61	3.30	3.93	118.9
31	3.31	3.72	112.5
57	3.33	3.15	94.6
58	3.34	3.11	93.1
80	3.35	2.92	87.2
35	3.36	3.03	90.2
21	3.40	3.13	92.2
53	3.40	3.43	101.0
63	3.44	3.25	94.5
62	3.47	3.27	94.6
52	3.48	3.38	97.3
50	3.51	3.38	96.5
29	3.52	3.43	97.1
12	3.53	3.48	98.0
28	3.56	3.63	102.1
78	3.57	3.14	88.1
36	3.58	3.64	101.8
41	3.58	3.66	102.2
45	3.59	3.84	107.0
54	3.59	3.43	95.6
30	3.60	3.37	93.6
7	3.60	3.90	108.3
74	3.61	5.11	155.0
8	3.62	3.77	104.3
20	3.62	3.46	95.6
34	3.62	3.61	99.7
76	3.62	4.27	120.7
48	3.63	4.17	114.8
44	3.64	3.31	91.0
46	3.64	3.16	86.8
67	3.64	3.79	104.2
43	3.65	3.39	92.9

No. of churning.	Per ct. of fat.	Per ct. of butter.	Per ct. relation of butter to fat
56	3.66	3.29	90.0
23	3.67	3.51	95.7
49	3.67	3.74	102.0
39	3.73	3.54	95.0
64	3.74	3.79	104.2
38	3.75	3.57	95.3
19	3.76	3.98	106.0
85	3.78	4.58	121.4
26	3.80	3.77	99.2
59	3.82	2.97	77.8
14	3.87	4.23	109.4
6	3.89	3.48	89.6
47	3.94	4.08	103.7
22	3.95	3.82	96.8
33	3.97	4.05	101.6
40	3.97	3.15	79.3
71	3.98	4.26	107.0
73	4.00	5.15	128.6
84	4.04	4.26	105.4
11	4.05	4.29	105.8
13	4.05	4.25	104.9
5	4.06	3.77	92.9
69	4.08	5.02	123.1
9	4.09	3.48	85.2
3	4.10	4.01	97.9
60	4.10	3.46	84.3
68	4.12	4.18	101.5
66	4.16	0	0
4	4.21	4.26	101.2
17	4.23	3.92	92.7
32	4.28	4.57	107.3
83	4.28	3.85	91.2
72	4.29	3.82	89.1
70	4.31	6.05	140.2
2	4.35	4.10	95.4
37	4.35	4.33	99.6
24	4.43	4.53	102.3
1	4.44	4.23	95.4
16	4.48	4.30	95.9
82	4.53	4.62	101.9
27	4.75	4.67	99.3
42	4.89	5.03	104.5
10	5.08	4.56	89.2
15	5.49	4.30	95.4

JUNO.

No. of churning.	Per ct. of fat.	Per ct. of butter.	Per cent. relation of butter to fat.
22	3.00	2.53	84.5
79	3.01	1.96	65.1
67	3.10	2.91	93.8
55	3.11	3.03	97.6
81	3.28	1.46	44.5
63	3.30	3.50	106.0
80	3.31	1.81	54.7
29	3.33	3.01	90.3
77	3.33	2.81	84.5
36	3.37	2.76	81.9
52	3.45	2.83	82.1
47	3.46	3.52	101.8
46	3.50	3.35	93.5
66	3.50	2.98	85.3
51	3.52	3.18	90.6
12	3.53	3.46	98.0
41	3.53	3.98	112.9
18	3.55	3.26	91.8
20	3.56	3.23	90.9
24	3.58	0	0
45	3.63	3.32	91.3
58	3.64	2.67	73.5
26	3.66	3.56	97.1
44	3.68	3.18	85.3
70	3.68	3.20	87.0
13	3.69	3.80	103.1
59	3.69	3.31	89.7
42	3.70	3.46	93.5
56	3.70	3.08	83.3
83	3.72	3.75	100.8
49	3.72	3.31	88.4
60	3.77	3.51	93.1
65	3.77	3.27	86.7
48	3.79	3.21	84.6
27	3.80	3.31	87.1
61	3.82	2.97	75.2
69	3.82	3.02	89.0
23	3.83	3.44	90.0
78	3.83	3.26	85.1
54	3.84	3.53	92.1
31	3.85	3.17	82.3
53	3.86	3.38	87.7
74	3.87	3.46	89.4
68	3.88	3.16	81.5
86	3.88	2.53	65.3
21	3.91	3.22	82.5
82	3.91	2.95	75.4
19	3.94	2.43	61.7

No. of churning.	Per ct. of fat.	Per ct. of butter.	Per cent. relation of butter to fat.	No. of churning.	Per ct. of fat.	Per ct. of butter.	Per cent. relation of butter to fat.
30	3.97	3.27	82.4	84	4.44	3.71	83.5
57	3.97	3.62	91.2	87	4.48	3.79	84 6
76	4.03	4.54	112.7	40	4.57	3.82	85.8
8	4.03	3.77	93.6	5	4.66	4.34	93.2
7	4.07	3.93	96.6	2	4.74	4.51	94.5
39	4.08	3.86	94.6	28	4.75	4.05	85.2
50	4.10	4.42	100.7	25	4.86	4.63	95.3
62	4.10	3.46	84.3	4	4.87	4.13	84.4
6	4.19	4.01	95.7	1	5.05	4.82	95.5
17	4.19	4.18	99.8	43	5.09	5.33	104.6
32	4.19	3.73	88.8	15	5.14	3.09	60.1
73	4.23	3.63	86.0	72	5.29	7.49	141.6
11	4.26	4.50	105.6	33	5.36	5.60	104.3
71	4.26	4.23	99.4	34	5.36	5.67	105.7
37	4.28	3.88	90.8	16	5.68	5.72	100.8
85	4.33	2.78	64.3	38	5.68	5.50	96.9
3	4.34	3.63	83.7	10	5.78	4.89	84.7
9	4.35	2.73	62.9	75	6.14	4.08	66.5
35	4.35	4.27	97.0				

Numbers 1–5 and 29–34 were in the periods when hay alone constituted the ration; Nos. 6–28 hay and "wet feed;" Nos. 35–46 "dry feed" and hay; Nos. 47–63 when acid was added to the dry feed ration; Nos. 64–73 sweet "wet feed" and hay, and Nos. 74–87 hay and corn meal.

We see by the irregular manner in which these numbers are distributed that little influence on the per cent. of fat can be attributed to the food. It also shows that while the per cent. of butter increases gradually with the per cent. of fat, the per cent. of fat recovered has been about the same from the poor as from the rich milk.

The following table in which the results of all churnings, in which butter was obtained, are grouped according to the yield of milk at the times tested shows the influence that this had on the fat, butter and economy of the churn.

CERES.

Weight of milk at milkings.	Average per cent of fat.	Average per cent of butter.	Per cent relation of butter to fat.	Ounces of butter per milking.
Under 10 lbs	4.48	4.46	99.6	6.2
10 to 11 "	4.49	4.49	100.	7.5
11 to 12 "	3.78	3.73	98.7	6.9
12 to 13 "	4.16	4.13	99.3	8.2
13 to 14 "	3.71	3.67	99.	7.9
14 to 15 "	3.89	4.06	104.4	9.3
15 to 16 "	3.72	3.62	97.3	9.0
16 to 17 "	3.47	3.36	97.1	8.8
17 and over	3.58	3.55	99.4	10.8
Average	3.82	3.80	99.6	--------

JUNO.

Weight of milk at milkings.	Average per cent of fat.	Average per cent of butter.	Per cent relation of butter to fat.	Ounces of butter per milking.
Under 8 lbs.	4.71	4.41	93.6	5.1
8 to 9 "	4.23	3.47	82.	4.6
9 to 10 "	3.92	3.34	85.2	5.0
10 to 11 "	4.22	3.77	89.3	6.3
11 to 12 "	4.19	4.01	95.7	7.3
12 to 13 "	3.95	3.48	88.1	7.0
13 to 14 "	3.68	3.25	88.3	7.0
14 to 15 "	3.82	3.49	91.3	8.1
15 to 16 "	3.56	3.43	96.4	8.4
16 and over	3.94	3.28	83.3	8.7
Average	4.02	3.59	89.3	--------

With both cows the per cent. of fat diminishes quite regularly with the increase of milk, while the relation between the fat and the butter does not seem to be materially affected by it. On the other hand while the per cent. of butter is considerably larger with the small yields, the total yield of butter is much larger with the largest amount of milk.

Throughout all the tests there has been a marked difference both in the character and behavior of the milk from the two cows, due not to difference in food or treatment, as this was the same for both, but to the individuality of the cows. By reference to the last table we observe that although Juno's milk has contained a larger percentage of fat, Ceres' milk has made the most butter both in per cent. and in total weight. Ceres' butter has also been of better quality than has Juno's, both in color and texture.

On the other hand Ceres' milk was the most difficult to churn; the average time required for her milk being one hour, while with Juno the time was 50 minutes. In 26 trials it was necessary to warm Ceres' milk before butter could be obtained. This was the case in only two trials with Juno's milk. Three samples of Ceres' milk were churned repeatedly without obtaining a trace of butter. This was the case in only one of Juno's. No satisfactory explanation of these facts can at present be given, and until more is known concerning the physical properties of milk and the butter fats, such results will continue to puzzle the investigator.

During the trial frequent determinations were made of the number and size of the fat globules of the milk from each cow. The result shows the average number of globules in .0001 cubic millimeter of milk as equal to 201 for Ceres, and 285 for Juno. The relative size obtained by dividing the amount of fat by the number of globules is for Ceres 172, and for Juno 140. The larger globules in

Ceres' milk may in a measure account for the greater economy of the churn with her milk, but suggests to us no explanation of the fact that it was more difficult to churn.

On several occasions equal quantities of milk from the two cows were mixed and then treated in the same way as samples of the separate milks. Contrary to expectation, no change was shown in the quantity of butter from the mixed milk and from the milk churned separately. The average per cent. of butter obtained from Ceres' milk was 3.65, from Juno's 3.39, and from the mixed milk 3.52, which happens to be just the average of the two, and in no case did the per cent. of butter from the mixed milk vary from the average of the two cows more than would be expected from duplicate churnings.

TEST OF JEM.

The Jersey cow, Jem, calved Feb. 8, and averaged for the last 16 days of the month 20 lbs. and 9 ounces of milk per day. At this time and until March 14 her ration consisted of what hay she would eat, ranging from 20 to 25 lbs., and 4 quarts (about 5 lbs.) of corn meal per day. Early in march a few tests of her milk were made, which gave a high percentage of butter, and confirmed the belief that with proper feeding she would make a notable record. With this end in view, commencing March 14, her grain ration was increased by the addition of ground oats and wheat bran, and after a few days a further addition of oil meal. At no time was the feeding excessive, the aim being to see what could be done with a generous ration that might be continued indefinitely without injury to the cow. After March 14 till the end of the experiment she received each day ten lbs. of a mixed feed, composed of 5 lbs. of ground oats and 2 1-2 lbs. each of wheat bran and corn meal, and what hay she would eat clean. In addition to the above she received March 17 and 18, 3 lbs. of oil meal. From the 19th till the 30th, inclusive, she received 2 lbs. of oil meal daily. The oil meal was then discontinued till after April 10, the remainder of the ration being as before. From this time till the end of the trial, two lbs. of oil meal were again added. We may therefore divide the trial into four periods, in which the rations were as follows:

Period I. Preliminary. Extending from March 1 to 18 inclusive. Ration previous to March 13, hay and 5 lbs. of corn meal. The hay consumed was not weighed every day, but ranged from 20 to 25 lbs. The average is assumed as 22 lbs. March 13, 20 lbs. hay, 2 lbs. crushed oats, 3 1-2 lbs. corn meal, 1 lb. bran; 14th, 21 lbs. hay, 4 lbs. crushed oats, 2 lbs. meal, 2 lbs. bran; 15th, 20 lbs. hay, 5 lbs. crushed oats, 2 1-2 lbs. meal, 2 1-2 lbs. bran; 16th, 15 lbs. hay, 5 lbs. crushed oats, 2 1-2 lbs. bran, 2 1-2 lbs. corn meal, 1 lb. oil meal; 17th, 19 lbs. hay, 5 lbs. crushed oats, 2 1-2 lbs. meal, 2 1-2 lbs. bran, 3 lbs. oil meal; 18th, 21 lbs. hay, 5 lbs. crushed oats, 2 1-2 lbs. bran, 2 1-2 lbs. corn meal, 3 lbs. oil meal.

Period II, from March 19 to 30 inclusive. Ration, hay and 12 lbs. of mixed feed, composed of 5 lbs. of ground oats, 2 1-2 lbs. each of wheat bran and corn meal, and 2 lbs. of oil meal. The hay given varied from 5 to 20 lbs., the average for the whole period being

13.6 lbs., but as the amount was much larger at first, it is averaged for each four days of the period. The 1st being 18.2 lbs.; 2d, 13.8 lbs., and the last 8.8 lbs.

Period III, Mar. 31 to Apr. 9 inclusive. Ration, hay and a mixed feed same as period II, except the oil meal. The hay eaten averaged for the period 12 1-2 lbs. per day. The average for the first three days being 6.7 lbs., for the next three days, 16.7, and for the last four days, 13.7.

Period IV, Apr. 10 to 15 inclusive. Ration same as period II. The hay eaten averaged 9 lbs. per day. The average for the first three days being 6.3, and for the last three days, 11.7 lbs.

The analyses of the substances composing these rations are given below:

	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free extract.	Ether extract.
Hay	12.97	5.22	7.02	34.35	38.17	2.27
Corn meal	15.80	1.05	10.31	1.58	67.64	3.62
Ground oats	13.26	2.94	10.30	18.37	50.75	3.38
Wheat bran	15.83	5.43	13.99	13.14	50.11	1.50
Oil meal	12.04	4.96	29.91	10.99	38.87	3.23

From this is derived the following table, in which is given the weight in pounds of each constituent of the ration, except ash, consumed per day. The water contained in the food is added to that drank. The water drank in period I is assumed as 80 lbs. per day, this being the average for this cow in an experiment when the ration was similar.

PERIOD I.

	Water, lbs.	Albuminoids, lbs.	Fiber, lbs.	Nitrogen free extract, lbs.	Fat, lbs.	Ratio of albuminoids to remainder of ration.
Prev. to M'ch 13, per day	80	2.06	7.63	11.78	.69	1:9.7
March 13	80	2.11	7.43	11.67	.67	1:7.9
" 14	90.9	2.37	8.30	11.90	.71	
" 15	86.4	2.52	8.20	13.12	.77	
" 16	81.5	2.47	6.58	11.59	.69	
" 17	91.3	3.35	8.17	13.88	.88	
" 18	104.5	3.49	8.85	14.64	.92	

PERIOD II.

Average per day.						
March 19, 20, 21 and 22	94.1	3.00	7.77	13.21	.77	1:7.2
" 23, 24, 25 and 26	92.5	2.70	6.26	11.42	.66	1:6.8
" 27, 28, 29 and 30	92.8	2.35	4.54	9.61	.54	1:6.2

PERIOD III.

March 31, April 1, 2,	84	1.59	3.69	8.04	.44	1:7.6
April 3, 4, 5,	80	2.29	7.13	11.84	.67	1:8.6
" 6, 7, 8, 9	92	2.08	6.10	10.70	.60	1:8.3

PERIOD IV.

April 10, 11, 12	81	2.16	3.68	8.65	.49	1:6.
" 13, 14, 15	90	2.55	5.54	10.72	.62	1:6.6

In the table which follows are given the milk and butter yields previous to and during the trial, only one butter test having been made in Feb.

Date.	Milk: lbs.	oz.	Fat: per cent.	Butter. per cent.	oz. per day.	
Feb. 13–28	28	9		m. 5.09		
March 1	28	10		—		
“ 2	25	9	m. 4.26	m. 5.18*	12.2	
“ 3	26	1		—		
“ 4	27	2		m. 7.47* e. 6.99*	19. 12.6	31.6
“ 5	30	6				
“ 6	29	6		m. 6.39* e. 8.06*	17.5 15.	32.5
“ 7	28	13		—		
“ 8	28	6		—		
“ 9	29	15		—		
“ 10	28	1		—		
“ 11	27	8		—		
“ 12	28	9		—		
“ 13	25	7		e. 8.31*	13.5	30.42
“ 14	27	9		m. 6.55*	16.9	
“ 15	27	14		—		
“ 16	28	13		—		
“ 17	30	4	m. — e. 6.54	—		
“ 18	29	—	m. 4.37 e. —	m. 5.16*	13.8	
“ 19	30	3		—		
“ 20	29	7	m. — e. 5.41	5.56*	53.3	
“ 21	30	7	m. 4.25 e. 4.76			
“ 22	28	4				
“ 23	29	15	—	—	—	
“ 24	29	15				
“ 25	29	4	m. 4.01 e. 5.24	4.88	47.3	
“ 26	31	6	m. 4.25 e. 4.76			
“ 27	32	3	—	—	—	
“ 28	30	9	—	—	—	
“ 29	34	6	m. 3.92 e. 5.85	5.60	30.8	
“ 30	31	10	m. 4.69 e. 5.83	5.35	27.1	
“ 31	31	5	m. 4.43 e. 5.18	5.27	26.9	
April 1	32	3	m. 4.14 e. 4.79	5.05	26	

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* Calculated from weight of moist butter.

Date.	Milk: lbs.	oz.	Fat: per cent.	Butter. per cent.	oz. per day.
" 2	32	13	m. 3.98 e. 4.88	4.84	50.2
" 3	32	1	m. 4.05 e. 5.08		
" 4	30	13	m. 4.86 e. 5.09	7.00	34.5
" 5	31	2	——	6.49	32.3
" 6	31	6	m. 4.22 e. 5.38	6.40	32.1
" 7	32	8	m. 4.64 e. 5.46	5.32	27.7
" 8	31	13	m. 4.11 e. 5.03	5.07	25.8
" 9	31	11	m. 4.15 e. 5.94	5.00	25.3
" 10	31	15	m. 3.85 e. 5.55	4.83	24.7
" 11	32	3	m. 3.83 e. 5.06	4.75	24.5
" 12	31	12	m. 4.54 e. 5.24	5.23	26.6
" 13	33	7	m. 4.09 e. 6.44	4.99	26.7
" 14	30	10	m. 4.64 e. 5.44	4.63	22.7
" 15	31	10	m. 4.33 e. 5.13	4.93	24.8

The most obvious effects of the rations fed as shown in the above tables was to considerably increase the quantity of milk given, and in a still greater degree to reduce its quality, especially for the purpurpose of butter production. This is evident not only in the diminished per cent. of fat in the milk and of butter obtained, but in the total amount of butter per day.

The average per cent. of fat found in 130 previous trials of Jem's milk at the Station has been 6.16, and of 76 trials made at about the same time after calving as in this test, and when the yield of milk was nearly as large was 5.26. The per cent. of butter calculated on the same basis as those in this test, in 122 previous trials, has averaged 6.62. In view of these facts, and the large yield of butter obtained in the few trials made early in March, it seems fair to attribute the smaller yields of the above test to the ration fed. By comparing the yields of butter and the ratio of albuminoids to the remainder of the ration, it will be seen that the yield of butter has diminished quite regularly as the proportion of albuminoids has increased. This is clearly shown in the next table, where these are brought together.

Date.	Average yield of butter per day, in ounces.	Ratio of albuminoids to remainder of ration.
Mar. 4–14	31.5	1 : 9.7
" 19–30	27.	1 : 6.7
" 30–Apr. 10	28.1	1 : 8.2
Apr. 10–15	25.	1 : 6.3

This would have been still more marked had each period been extended for two or three days into the next as would have been proper to do, as the effect of a ration continues some time after it is discontinued.

This result was entirely unexpected, as the rations usually given in the published records of tests which have given phenominal yields have, almost without exception, been highly nitrogenous, and further, with the exception of pea meal, have been made up of the same materials which composed these rations.

One thing at least was made evident during this test, and that is the difficulty of controlling the composition of the ration eaten, as the animal by refusing a portion may materially change any predetermined relation between its constituents.

The butter obtained in all tests, in this trial, made subsequent to March 21 was weighed in the granulated form as taken from the churn after being washed and drained. This butter was afterwards thoroughly worked and salted at the rate of one ounce to the pound. The percentages given are calculated on this basis. In the tests made previous to this date only the weight of granulated butter was taken, and in these cases the per cent. given has been calculated by deducting the average loss in working and salting as obtained from the later trials. This loss was 16.11 per cent.

In the following table appears the result of determinations of the number and relative size of the butter globules in Jem's milk during the trial.

Date.	No. of globules in .0001 cubic millimeter.	Relative size.	Skimmed milk No. of globules in .0001 cubic millimeter.
Mar. 13 e.	155	390	23
" 14 m.	97	——	
" 18 m.	108	405	
" 20 m.	140	——	28
" 20 e.	156	347	38
" 21 e.	170	384	47
" 29 m.	79	500	16
" 29 e.	109	491	27
" 30 m.	92	510	21
" 30 e.	133	439	28
" 31 m.	112	395	26
" 31 e.	151	343	33
Apr. 1 m.	123	337	27
" 1 e.	149	321	38
" 2 m.	118	337	29
" 2 e.	157	311	
" 3 m.	139	291	
" 3 e.	148	343	

Date.	No. of globules in .0001 cubic millimeter.	Relative size.	Skimmed milk No. of globules in .0001 cubic millimeter.
April 4 m.	133	365	
" 9 e.	184	323	47
" 10 e.	172	323	52
" 11 m.	136	281	
" 11 e.	165	307	40
" 12 e.	134	391	34
" 13 m.	147	279	25
" 13 e.	184	350	
" 14 m.	145	320	47
" 14 e.	170	320	
" 15 m.	157	276	
" 15 e.	171	239	
Average	141	354	
Av. for morning	123	358	
" " evening	157	351	

JERSEY TESTS.

During the past winter and spring several phenomenal yields of butter were reported in the public press, some of which were so remarkable, both in the quantity of butter claimed and in the ratio of butter to milk, that the suspicion of some deception having been practiced was quite prevalent even among breeders interested in the stock tested. In view of this, and in the hope of discovering the secret of these yields, an open letter to breeders associations was issued by the Director of the Station, offering the services of a chemist to make analyses of the milk and products during a test.

In response to this letter, Mr. F. Bronson, president of the American Jersey Cattle Club, invited the Station to send a representative to be present at an official test of three cows of his herd. This invitation was accepted, and I was assigned to the duty. I was present with the official tester, Mr. Edward Burnett, at each milking of the first five days of the trial, and saw the milk weighed and set. Samples were taken of the new milk from each milking, and of the skim-milk, butter and buttermilk from the first churning, which were analyzed with the results given below:

The cows tested were Hilda D, 6683, 9 years old, last calf March 22, 1885 ; Evelina of Verna, 10971, 6 years old, last calf March 31, 1885 and Edessa, 21844, a two-year-old heifer, last calf March 14, 1885. The trial began on the evening of June 22, at 6 P. M., the cows being milked out at that time, and continued seven days.

The details of the test as they appeared in the tabulated report of Mr. Burnett, are inserted.

TEST OF HILDA D, 6683, PROPERTY OF F. BRONSON, ESQ., GREENFIELD HILL, CONN.

DATE. 1885. June	Weather.	Feed and grain.	Milked at 5.10 A.M 1.10 P.M 9.10 P.M		Total milk each day.		CHURNINGS.				Condition of butter.	WEIGHT OF BUTTER.						Remarks.
							Date.	Temperature.	Time.			From the churn.		Worked.		Salted 1 oz. to the lb.		
			lbs.	oz.	lbs.	oz.	June		H.	M.		lbs.	oz.	lbs.	oz.	lbs.	oz.	
23	Fine, about 68°	Pasturage and 10 lbs. corn meal, 10 lbs. pea meal, 8 lbs. crushed oats, 2 lbs. bran, & 1 pt. linseed m'l.	17 12 12	4 1 0	41	5												
24	Fine. about 70°	Pasturage and 5 lbs. corn meal, 5 lbs. pea meal, 6 lbs. crushed oats and 1 pt. linseed meal.	10 10 11	10 15 12	35	5	27	66°	1	10	Granular, fine col.	7	15	5	7	5	8	Milk set (about 92°) in Cooley Creamer, 36 hours; water 40° to 45°.
25	Fine, about 75°	Same as above	12 11 12	8 3 2	35	13												
26	Sultry, about 78°	Same as above	12 11 11	11 2 15	35	12	29	65°	0	40	Granular, fine col.	8	13	8	8	8	1	Cream ripened at 62°, and churned in Mosely & Stoddard barrel churn and rinsed three or four times with brine. Thoroughly worked and salted.
27	Fine, about 78°	Same as above	11 12 12	13 2 0	35	15												
28	Foggy A. M.; P. M. warm about 80°	Same as above	12 10 11	7 9 8	34	8	July1	63°	1	20	Granular, fine col.	7	8	7	6	7	9½	The preparing and working of butter at each churning occupied fr'm 25 to 30 minutes.
29	Hot and sult'y, ab't 82°	Same as above	13 10 6	5 12 13	30	14												
					249	8						24	4	21	5	21	2½	E. BURNETT, *Tester*.

Test of Evelina of Verna, 10971, Property of F. Bronson, Esq., Greenfield Hill, Conn.

Date. 1885. June	Weather.	Feed and Grain.	Milked at 5.10 A.M 1.10 P.M 9.10 P.M		Total milk each day.		Churnings.			Condition of butter.	Weight of Butter.						Remarks.
							Date.	Tempera-ture.	Time.		From the churn.		Worked.		Salted 1 oz. to the lb.		
			lbs.	oz.	lbs.	oz.	June		Min.		lbs.	oz.	lbs.	oz.	lbs.	oz.	
23	Fine, about 68°	Pasturage and 10 lbs. corn meal, 10 lbs, pea meal, 8 lbs. crushed oats, 2 lbs. bran, 1 pt. linseed meal.	18	7													Milk set (about 92°) in Cooley Creamer about 36 hours.
			12	10													
			12	2	43	3											
24	Fine, about 70°	Same as above	13	4													Water 40° to 45°.
			11	12													
			12	6	37	6	27	66°	40	Granular, fine col.	6	8	5	9½	5	5	Cream ripened at 62° and churned in Moseley & Stoddard barrel churn.
25	Fine, about 75°	Same as above	12	9													
			12	2													
			11	14	36	9											
26	Sultry, about 78°	Same as above	13	1													Butter when in fine granular form rinsed with three or four applications. Then thoroughly worked and salted.
			11	15													
			12	1	37	1	29	66°	31	Granular, fine col.	9	7½	8	10	8	3½	
27	Fine, about 78°	Same as above	13	0													
			11	12													
28	Foggy, A. M.; showe's P. M., about 80°	Same as above	12	9	37	5											
			13	15													
			12	1													The preparing and working of butter occupied for each churning from 25 to 30 minutes.
			13	0	39	0	July 1	63°	49	Granular, fine col.	7	6	6	4	6	2	
29	Hot and sult'y ab't 82°	Same as above	14	8													
			12	2													
			7	11	34	5											
					264	13					22	5½	20	7½	19	10½	E. Burnett, *Tester.*

TEST OF EDESSA, 21844, PROPERTY OF F. BRONSON, ESQ., GREENFIELD HILL, CONN.

DATE. 1885. June	Weather.	Feed and Grain.	Milked at 5.20 A.M. 5.20 P.M.		Total milk each day.		CHURNINGS.			Condition of butter.	WEIGHT OF BUTTER.						Remarks.
							Date.	Tempera-ture.	Time.		From the churn.		Worked.		Salted 1 oz. to the lb.		
			lbs.	oz.	lbs.	oz.	June		H. M.		lbs.	oz.	lbs.	oz.	lbs.	oz.	
23	Fine, about 68°	Pasturage and 8 lbs. pea meal, 8 lbs. corn me'l, 9 lbs. crushed oats, 3 lbs. bran, 1 pt. linseed meal.	12 11	8 11	24	3											First 3½ days' milk set in shallow pans at 62°, churned whole after 60 and 70 hours' setting: mostly loppered. Last 3½ days' milk set in Cooley Creamer 36 h'rs. All the churnings were made in Moseley & Stoddard churn and the preparing and working of butter each time occupied from 25 to 30 m't's.
24	Fine, about 70°	Same	12 12	10 2	24	12	26	65°	1 30	Granular, soft, color fair			1	3	1	4	
25	Fine, about 75°	Same	12 12	10 6	25		28	68°	0 30	Granular, soft, color fair			1	6½	1	7	
26	Sultry, about 78°	Same	12 13	6 0	25	6	29	64°	2 50	Granular, good, color fair			2	0	2	2	
27	Fine, about 78°	Same	11 12	4 3	23	7											
28	Foggy A. M.; showers P. M., about 80°	Same	12 11	1 10	23	11	July 1	65°	15	Granular, good color	6	3½	5	13	5	9½	
29	Hot and sult'y, ab't 82°	Same	12 12	6 6	24	12											
					171	3							10	6½	10	6½	E. BURNETT, *Tester*.

The analytical results are presented in the following table :

Hilda D.

Milk.

Date.	Solids, per cent.	Fat, per cent.	Fat, ounces in milking.
June 23, 5 A. M.	15.74	5.71	15.76
" " 1 P. M.	16.23	6.33	12.22
" " 9 P. M.	15.63	5.75	10.04
" 24, 5 A. M.	15.74	5.91	11.94
" " 1 P. M.	15.40	5.52	9.66
" " 9 P. M.	16.26	5.73	10.77
" 25, 5 P. M.	15.90	5.41	
" " 1 P. M.	16.05	5.90	
" " 9 P. M.	15.79	5.96	
" 26, 5 A. M.	15.64	5.75	
" " 1 P. M.	15.63	5.45	
" " 9 P. M.	15.37	5.70	

Skimmed milk.

	Solids. per cent.	Fat. per cent.
From milk of June 23, 5 A. M. and 1 P. M.	10.53	.092
" " " " " 9 P. M.	10.52	.096
" " " " 24, 5 A. M. and 1 P. M.	10.28	.091
Buttermilk from churning of cream of June 23–24	10.80	.34

Butter.

	Churning of cream from milk of June 23-24.	Churning of July 1.
Water, per cent.	14.51	21.47
Ash " "	6.42	3.26
Fat " "	78.51	74.09
Casein " "	.62	.84
Fat in butter, ounces	69.09	——

Melting point of butter fat = 96° F.

Evelina of Verna.

Milk.

Date.	Solids, per cent.	Fat, per cent.	Fat, ounces in milking.
June 23, 5 A. M.	14.45	5.06	14.93
" " 1 P. M.	16.51	6.59	13.31
" " 9 P. M.	15.28	5.25	10.19
" 24, 5 A. M.	14.92	5.01	10.62
" " 1 P. M.	15.48	6.01	11.30
" " 9 P. M.	15.11	5.58	11.05
" 25, 5 A. M.	15.21	5.77	
" " 1 P. M.	15.50	5.81	
" " 9 P. M.	14.84	5.30	
" 26, 5 A. M.	14.96	5.33	
" " 1 P. M.	15.53	6.02	
" " 9 P. M.	14.80	5.66	

Skimmed milk.

	Solids, per cent.	Fat, per cent.
From milk of June 23, 5 A. M. and 1 P. M.	9.96	.07
“ “ “ “ “ 9 P. M.	10.00	.44
“ “ “ “ 24, 5 P. M.	——	.12
Buttermilk from churning of cream of June 23–24	10.22	.63

Butter.

	Churning of June 27 from cream of June 23 and 24.	Churning of July 1.
Water, per cent.	14.60	12.65
Ash “ “	1.95	1.33
Fat “ “	83.21	84.91
Casein “ “	.51	.69
Fat in butter, ounces	70.73	——

Melting point of butter fat 93° F.

EDESSA.

Milk.

Date.	Solids, per cent.	Fat, per cent.	Fat, ounces in milking
June 23, 5 A. M.	14.25	5.15	10.30
“ “ 5 P. M.	14.76	5.68	10.62
“ 24, 5 A. M.	14.89	4.85	
“ “ 5 P. M.	14.64	4.94	
“ 25, 5 A. M.	15.57	4.98	
“ “ 5 P. M.	14.40	4.51	
“ 26, 5 A. M.	15.31	4.72	
“ “ 5 P. M.	15.02	5.21	

Buttermilk.

From churning of whole milk of June 23.

Solids.	Fat.
12.08	2.23

Butter.

	Churning of June 26 from whole milk of June 23.	Churning of July 1.
Water, per cent.	15.85	14.37
Ash “ “	8.83	5.13
Fat “ “	74.01	79.63
Casein “ “	.52	.56
Fat in butter, ounces	14.08	——

Melting point of butter fat 89° F.

The milk of Hilda D for June 23 and 24, which constituted the first churning, contained in the aggregate according to the analysis 71.39 ounces of butter fat. The butter obtained from this contained 69.08 ounces which is 96.79 per cent. of the fat in the milk.

The milk of Evelina for the same time contained 71.4 ounces of butter fat, and there were recovered in the butter 70.73 ounces or 99 per cent.

Edessa's milk for June 23 contained 20.92 ounces of fat, and the butter from it contained 15.8 ounces or 79.01 per cent.

No extended discussion of the above figures will be made at present, but they deserve the careful study of all who are interested in the development of the butter industry, as they show what may be done by the judicious selection of cows and the skillful management of milk. Such thorough separation of the butter as was obtained from the milk of both Hilda D and Evelina of Verna cannot be expected from all animals nor from any if the milk is handled in a careless manner.

The test of Edessa, during the first 3½ days of which the whole milk was churned and only the cream for the remainder of the time, shows in a marked way the advantage of separating the cream and churning it alone.

In the first three days the whole milk produced 5.58 per cent. of butter, while afterward the cream alone gave 6.59 per cent.

During the trial several determinations were made of the number and size of the fat globules of the milk from each cow. These are given.

HILDA D.

Date.	No. of globules in .0001 cubic millimeter.	Relative size.
June 23, A. M.	113	505
June 23, Noon.	130	487
June 25, A. M.	133	407
June 26, A. M.	132	436
Average,	127	459

Skimmed Milk.

June 24, A. M. and Noon.	4	227

EVELINA OF VERNA.

June 23, A. M.	130	389
June 23, Noon.	180	366
June 25, Noon.	155	374
June 26, A. M.	167	320
Average,	158	383

Skimmed Milk.

June 23, A. M. and Noon.	6	116
June 24, A. M. and Noon.	6	200

EDESSA.

June 23, A. M.	282	183
June 24, A. M.	270	180
June 25, A. M.	262	190
Average,	271	184

Samples of each kind of meal fed during the trial were analyzed. The figures obtained appear in the following table :

	Water per ct.	Ash per ct.	Albuminoids per cent.	Crude fiber.	Nitrogen free extract per cent.	Ether extract per cent.
Pea meal	12.08	2.61	21.37	11.06	52.02	.86
Corn meal	10.25	1.36	9.08	1.18	73.55	4.58
Crushed oats	10.09	3.24	11.63	16.57	53.98	4.49
Wheat bran	12.62	5.68	14.91	15.50	45.53	5.86
Linseed meal	9.43	5.24	32.03	11.06	35.71	6.53

Calculated in pounds per day for each cow :

		Albuminoids pounds.	Fiber.	Nitrogen free extract, pounds.	Ether extract pounds.
Hilda D	June 24,	4.60	2.98	18.14	1.03
	June 25–29,	2.55	1.71	9.87	.60
Evelina of Verna,		4.60	2.98	18.14	1.03
Edessa,		4.25	3.03	16.61	1.07

In the absence of data concerning the condition of these cows preceding or subsequent to the feeding of the above ration, it is impossible to determine what effect it may have had upon them, but it was the impression of the herdsman that the addition of pea meal had been a disadvantage. Private tests of Hilda D had given a larger yield of butter per day than was obtained in the official trial. Moreover Hilda D was very lame during the test, this was attributed to the heavy ration which she received, and on this account the amount of grain given her was diminished nearly half on the second day. The amount of this reduction in pounds of the different constituents was: Albuminoids 2.05, Fiber 1.27, Nitrogen free extract 8.27, Fat .43, or sufficient nutriment to maintain a good cow while giving a fair quantity of milk. Compare the ration fed to the Jersey cow, Jem, during test at the Station. An inspection of the milk yields shows no reduction which can be attributed to the diminished ration, the large yield of the first day and the small yield of the last being due to the change in the time of milking, which made the first day three hours longer, and the last three hours shorter than the others. Nor was there any falling off in the quality of the milk, the butter yield being larger in the last part of the trial than the first.

SORGHUM.

On May 20, three of the experimental plats were planted with Early Amber Cane, the seed used being supplied by the Wisconsin Ex. Station. It was planted in hills 44 inches apart each way, from 4 to 7 stalks being left to each hill. It vegetated May 28, and was cultivated June 5, June 29 and July 20. Although the season was long and favorable to a large growth of cane, it was not sufficiently warm for it to reach a state of maturity most favorable for sugar production. Owing to the backwardness of the cane, no tests were made until Oct. 6, when some of the most advanced stalks were tested with the polariscope for cane sugar. At this time the seeds on the canes tested were hardly in the milk, the most of the plat being still in bloom. Other tests were made on Oct. 19 and on Oct. 24, the most of the seed being in the milk, none of it being hard and very little of it in the dough.

The results of these tests are given below :

		Av. wt. oz.			Sugar in juice of Sorghum.		
Date.	Average length of cane in feet.	stripped cane.	juice.	Sp. gr. juice.	Cane sugar by polar.	Glucose.	Total sugar.
Oct. 6	9	19	49.1	1.066	11.98	——	——
Oct. 19	9	19	44.0	1.068	12.16	2.81	14.97
Oct. 24	9	22	44.0	1.068	11.95	2.60	14.55

Some of the most promising varieties of sorghum have been planted in the experiment plats each of the four years since the establishment of the Station, and in only one of them (1882) has the crop reached maturity. The two following years all varieties were nearly a total failure.

LYSIMETER.

Throughout the year monthly examinations have been made of water from the three lysimeters in the same manner as in previous years. The results obtained have been unexpected and difficult of explanation. The amount of nitrates which the water has contained being, in parts per million, many fold what was found in the water from neighboring drains. This may be due to several undetermined causes, viz : difference in the composition of the soil, difference in the amount of nitrification, or the influence of the soil water in diluting or preventing drainage from the surface soil of the plats, etc.

These subjects are about to be tested experimentally, and discussion of our results is deferred until our experiments are completed, in the hope that more light may be thrown upon them. We insert, however, all results to date, including previous years as they appeared in the last annual report of this station.

The treatment of the soil in each lysimeter has been the same since they were placed in position, viz : No. 1 is covered with sod, the grass being kept short by frequent cuttings. No. 2 is kept free from all vegetation, its surface being left undisturbed. The surface of No. 3 is kept in a loose and fine condition by frequent stirrings with a trowel.

During the first year, 1883, the water from all of the lysimeters was mixed and analyzed together ; since January, 1884, the water from each has been examined separately. The determinations made have been total solids, chlorine, nitrogen in free ammonia and in nitrates.

1882.	Rainfall. Inches.	No. of days rainfall recorded.	Lysimeter Water Collected from		
			Sod. Inches.	Bare soil. Inches.	Cultivated soil. Inches.
August	2.371	10	.000	.135	.575
September	1.251	6	.000	.001	.284
October	0.621	7	.000	.000	.001
November	1.220	7	.000	.009	.011
December	0.550	4	.000	.271	.249
1883.					
January	0.482	13	.007	.052	.006
February	1.441	13	.142	.000	.000
March	0.880	12	.001	.001	.001
April	1.580	11	.001	1.291	1.566
May	4.451	16	1.204	2.439	3.010
June	4.120	12	1.204	1.151	2.154
July	2.980	13	.006	.320	.469
August	3.470	9	.000	.959	1.352
September	2.120	10	.000	.227	.632
October	2.100	10	.083	.964	1.353
November	1.540	5	.935	.801	.935
December	0.730	11	.165	.043	.031
1884.					
January	1.83	11	.059	.229	.055
February	2.01	14	2.062	1.540	1.769
March	2.54	16	1.320	1.629	1.611
April	0.83	11	.190	.062	.210
May	2.49	15	.000	.510	1.070
June	2.01	10	.015	.228	.090
July	2.33	12	.000	.278	.316
August	1.44	6	.000	.000	.000
September	3.17	7	.000	.103	.350
October	1.67	13	.000	.157	.165
November	1.01	8	.000	.000	.000
December	0.97	10	.000	.432	.352

1885.	Rainfall, in inches	No. of days rainfall recorded.	Lysimeter water collected from		
			Sod; inches.	Bare soil; inches.	Cultivated soil; inches
January	1.07	8	0	.266	.256
February	.61	5	0	0	0
March	.12	3	0	0	0
April	1.31	8	.074	.798	1.64
May	1.58	13	0	0	0
June	2.49	9	0	.012	.826
July	4.64	6	0	1.566	1.64
August	5.02	17	.008	1.351	1.559
September	2.11	5	0	.196	2.51
October	2.88	13	0	1.041	1.012
November	1.36	12	0	.713	.64
December	.76	12	.275	1.145	.906

The rainfall and drainage water for each lysimeter is given in the following table in tons of 2000 pounds per acre, the weight of a cubic inch of water being taken as .036024 pounds.

	Tons per acre.			
		Drainage water.		
1882.	Rainfall.	Sod.	Bare soil.	Cultivated soil.
August	267.88	.0	15.25	64.96
September	141.34	.0	.11	32.08
October	70.16	.0	.0	.11
November	137.89	.0	1.01	1.24
December	62.14	.0	30.61	28.13
1883.				
January	54.45	.74	5.87	.68
February	162.81	16.04	.0	.0
March	99.42	.11	.11	.11
April	178.51	.11	145.86	176.93
May	502.88	136.03	275.56	340.08
June	465.49	136.03	130.04	243.36
July	336.64	.67	36.15	52.99
August	392.05	.0	108.35	152.75
September	239.52	.0	25.64	71.40
October	237.26	9.37	108.91	152.81
November	173.99	105.14	90.49	105.64
December	82.47	18.64	4.86	3.50
1884.				
January	206.78	6.67	25.87	6.21
February	227.09	232.97	173.99	199.87
March	286.97	149.13	184.04	182.01
April	93.77	214.66	7.00	23.70
May	281.32	.0	57.62	120.89
June	227.09	1.70	25.76	10.17
July	263.25	.0	31.41	35.70
August	162.64	.0	.0	.0
September	358.15	.0	11.63	39.54
October	188.68	.0	17.73	18.64
November	114.11	.0	.0	.0
December	109.59	.0	48.81	39.77

1885.	Tons per acre.			
		Drainage water.		
	Rainfall.	Sod.	Bare soil.	Cultivated soil.
January	120.89	0	30.05	28.92
February	68.41	0	0	0
March	13.55	0	0	0
April	148.00	8.41	90.16	185.29
May	178.51	0	0	0
June	281.32	0	1.35	93.32
July	524.24	0	176.43	185.29
August	567.17	.90	152.64	176.14
September	238.39	0	221.44	283.58
October	325.39	0	117.61	114.33
November	153.65	0	80.55	72.31
December	85.86	31.07	129.36	102.36

The amount of solids, chlorine and nitrogen found in the mixed drainage water from the three lysimeters in 1883 and in the water from each lysimeter in 1884 and 1885 is given below.

Drainage water from the three lysimeters:

1883.	Total solids, grains, per gal.	Chlorine, grains, per gal.	Nitrogen as free ammonia, parts per million.	Nitrogen as nitrates parts per million.	Total nitrogen parts per million.
Jan. 1—Feb. 6	11.9	1.68	.206	2.76	2.966
Feb. 6—Apr. 16	46.7	3.36	1.029	55.94	56.969
April 16—May 20	26.9	2.59	.987	24.73	25.717
May 20—June 1	38.8	3.71	1.65	47.96	48.125
June	40.18	3.15	.428	55.90	56.328
July	44.24	3.3	.066	66.00	66.066
August	56.35	2.9	.330	97.00	97.330
September	47.95	2.5	.023	83.26	83.286
October	49.91	2.5	.066	92.26	92.326
November	37.73	3.2	.082	64.96	65.042
December	23.59	2.4	.132	25.24	25.253

Drainage from lysimeter No. 1, in sod:

1884.	Total solids, grains per gal.	Chlorine, grains per gal.	Nitrogen as free ammonia, parts per million.	Nitrogen as nitrates, parts per million.	Total nitrogen. parts per million.	Total loss of nitrogen in pounds per acre.
January	23.03	1.8	.0033	2.13	2.133	.02844
February	9.52	1.7	.033	.142	.175	.08154
March	10.92	1.5	.079	.142	.221	.06591
April	10.43	1.2	.099	.284	.383	.01644
May	----	--	----	----	----	----
June	----	--	----	----	----	----
July	----	--	----	----	----	----
August	----	--	----	----	----	----
September	----	--	----	----	- --	----
October	----	--	----	----	----	----
November	----	--	----	----	----	----
December	----	--	----	----	----	----

Lysimeter No. 2, bare soil:

January	15.4	.1	.03	trace	.03	.00155
February	19.11	1.2	.0132	20.529	20.542	7.1488
March	53.06	3.4	.0494	75.073	75.122	27 6524
April	46.97	4.7	.0987	90.02	90.119	1.2625
May	74.34	4.8	.395	117.92	118.315	13.6350
June	32.76	1.1	.0165	33.122	33.138	1.7073
July	42.77	1.5	.0296	34.80	34.829	2.1879
August	----	--	----	----	----	------
September	42.	3.6	.204	64.62	64.87	1.5087
October	63.14	5.2	.03	90.86	90.90	3.2244
Movember	----	--	----	----	----	------
December	70.42	4.5	.211	114.58	114.79	11.206

Lysimeter No. 3, cultivated soil:

January	39.00	1.75	.03	.426	.456	.00566
February	45.43	.9	.0132	69.61	69.623	27.8307
March	31.50	.8	.0494	52.164	52.213	19.0073
April	34.44	1.3	.296	65.62	65.916	3.1279
May	45.08	.9	.059	68.07	68.129	16.4725
June	31.78	.8	.023	23.94	23.963	48.4873
July	56.35	.9	.013	63.94	63.953	4.5666
August	----	--	----	----	----	------
September	46.90	1.	.0	69.60	69.60	5.5045
October	53.97	1.	.006	59.66	59.658	2.2246
November	----	--	----	----	---	------
December	44.73	.9	.064	62.97	63.03	5.0134

1885. No. 1, in sod.	Total solids; grains per gallon.	Chlorine; grains per gallon.	Nitrogen as free ammonia, parts per million.	Nitrogen as nitrates; parts per million.	Total nitrogen; parts per million	Loss of nitrogen in lbs. per acre.
January	----	----	----	----	----	----
February	----	----	----	----	----	----
March	----	---	----	----	----	----
April	19.9	1.5	.274	4.43	4.704	0.8
May	----	----	----	----	----	----
June	----	----	----	----	----	----
July	----	----	----	----	----	----
August	----	----	----	----	----	----
September	----	----	----	----	----	----
October	----	----	----	----	----	----
November	----	----	----	----	----	---
December	.14	2.5	.166	3.33	3.5	.22
Lysimeter No. 2, bare soil.						
January	55.3	4.4	.285	39.90	40.185	2.4
February	----	----	----	----	----	----
March	----	----	----	----	----	----
April	78.3	4	.812	102.09	102.902	16.3
May	----	----	----	----	----	----
June	----	----	----	----	----	----
July	55.44	3	.066	92.43	92.5	32.7
August	74.76	2.8	.10	119.00	119.1	36.3
September	68.11	3.2	.115	123.48	123.6	54.7
October	72.24	2.6	.12	125.	125.12	29.4
November	77.	3	.175	137.4	137.575	22.2
December	59.	1.5	.083	94.62	94.7	24.7
Lysimeter No. 3, cultivated soil.						
January	41.65	.9	0	20.75	20.75	1.2
February	---	----	----	----	----	----
March	----	----	----	----	----	----
April	48.7	1	.121	65.05	65.17	24.2
May	----	----	----	----	----	----
June	52.78	.9	.066	91.334	91.40	17.1
July	50.12	1.	.008	82.292	82,30	30.5
August	50.05	.9	.04	94.4	94.44	33.3
September	48.86	1.	.049	92.65	92.70	52.6
October	55.65	1.	.044	100.	100.04	22.9
November	58.	1.1	.092	103.	103.09	14.9
December	51.	1.	.05	104.95	105.	21.5

FERTILIZERS.

Only one analysis of fertilizers has been made during the past year, and we were led to the examination of this one by the obvious misrepresentations of the circular which accompanied it. The bulletin which announced the result of this analysis is inserted in full, showing as it does, clearly the fraudulent character of the article.

N. Y. Agricultural Experiment Station,

Geneva, N. Y., July 18, 1885.

On June 20, there was received at the Station a sample of fertilizer for analysis, with the following endorsement:

Brand of Fertilizer: Mason's High Grade Potash Fertilizer.

Name and address of manufacturer: Mason's High Grade Potash Fertilizers, Binghamton, N. Y.

Name and address of dealer from whose stock this sample is taken: George S. Ellis, Levanna, N. Y.

Date of taking this sample: June 18, 1885.

Selling price per ton or hundred: Wholesale price per ton, $22.50; $30.00 retail.

Actual weight of package opened: 350 lbs.

Copy of all the printing upon the bag or package: *Mason's high grade potash fertilizer, manufactured at Binghamton, N. Y.*

ANALYSIS:

Potash equivalent in sulphate	15
Lime	21
Magnesia	6
Chloride Sodium	5
Phosphoric acid, available salts	3
Ammonia, Salts of	6
Vegetable Mold	10
Moisture	27
Undetermined Elements	7
	100

J. G. ORTON, Chemist.

The Station analysis of the above sample gave the following results:

		Per cent.	Lbs. per ton.
Phosphoric acid soluble	(Available)	tr.	——
" " reverted		0.18	3.60
" " insoluble		0.43	8.60
Potash		0.005	0.10
Nitrogen		0.20	4.00
" evuivalent to ammonia		0.24	4.80
Lime		7.15	143.00
Moisture		28.21	564.20

An analysis made June 27, by Dr. F. A. Genth, for the Pennsylvania Board of Agriculture, gave the following results:

	Per cent.	Lbs. per ton.	A Value.
Soluble phosphoric acid	none	13.2	1.19
Reverted	0.66		
Insoluble	0.70	14	0.56
Potash	0.14	2.8	0.14
Ammonia	1.14	22.8	4.10

Comparative commercial value per ton	$ 5.99
Selling price per ton at point of selection	35.00

We will give the manufacturer the benefit of the advertisement by re-publishing his circular, which reads as below:

Mason's high grade potash fertilizer for all crops, the only fertilizer in the world manufactured from wood. Manufactured by Mason's Fertilizer Co., Binghampton, N. Y.

Some reasons why farmers should use Mason's potash fertilizer. This is the only fertilizer in the world produced from wood. A few years ago you would not have thought that the paper you read could have been manufactured from wood, but it is, and is conceded by all printers one of the best and most durable papers ever used. Now, we call the farmers' attention for a few moments to hard wood ashes. We ask them if they are a good fertilizer. Their answer is they are one of the best they ever used. If we could only get enough of them we would want no other fertilizer for our crops, as they say that the ashes is good for all crops, especially for wheat.

Now, we are placing before the farmers a fertilizer five times better than hard wood ashes, and at a low price, so all farmers can use it. Now, what we call the attention of the farmers to is this: Their good judgment will teach them that a fertilizer produced from the tree, containing fifteen per cent. potash, would be natural for the soil to retain it, as it is vegetable matter, and once grown from the soil. Now, think of year after year how you have robbed your land of all that has grown upon it, and put nothing back to feed it.

You will agree with us if we tell you that grape growers throughout the country know when they have burnt brush upon the soil before setting grape vines, the best of results have been produced, both in vine and quality of grape, by the ashes, together with other chemical properties from the wood, which have entered into the earth. We therefore beg to call the special attention of the grape growers to our fertilizer, as it is of such a quality as to be a natural food for the vine and grape, and is the only fertilizer ever produced from wood, and supplying the earth with that property which the vine in growing has exhausted.

All crops require more or less potash. The potato requires potash, as that itself when burnt the ashes is from 8 to 10 per cent. potash—the wheat the same. You feed any crop what it likes, natural food, and it will thrive. The same as your pig in the pen. If you feed him all the corn and milk he wants he will grow fat, but if you give him something that he does not like, he will not eat, and for weeks you can see no difference. It is just so with your crops.

Feed them what they like, they will grow, and potash is natural food for them. Now, we have placed before you one of nature's own fertilizers, adapted to all crops, soils and climates.

Our aim is to keep this a high grade, make it better in quality instead of less. As our judgment is that it will become very popular with the farmers, and as they use it in large quantities, it enables us to sell at a small margin, and give them the benefit.

We have already spent large sums of money in chemistry, and keep a chemist with us, so as to keep up the standard of our fertilizer.

We have also studied the nature, not only what is valuable to feed the straw, but the kernel as well. Farmers are well aware that they often get a heavy growth of straw, and think they are going to have a large crop, but there is something lacking to feed the kernel, and the crop is a failure. We claim that potash produced from wood is the only natural food in the world to feed the kernel. One trial will convince every farmer that they should use no other brand but Mason's High Grade Potash Fertilizer on all crops. Remember, this is the only fertilizer in the world produced from wood.

Farmers should take an interest in this fertilizer, as our aim is to give them value received for every dollar we receive from them. Some reasons why the farmers should give Mason's High Grade Fertilizer their attention. First—Because it costs but thirty dollars per ton at retail. Second—It is more bulky, free from sand and worthless material. Third—Because common sense will teach any one that vegetable matter is better for their land than mineral, as in the vegetable its nature is to grow; the mineral is not soluble. The ammonia produced from wood, its nature is to stay in the soil; the ammonia produced from the animal, its nature is to escape in the air.

For crops in general use from 250 to 300 lbs. per acre.

ANALYSIS OF MASON'S HIGH GRADE POTASH FERTILIZER.

Potash, equivalent in sulphate	15	Ammonia, Salts of	6
Lime	21	Vegetable Mold	10
Magnesia	6	Moisture	27
Chloride Sodium	5	Undetermined elements	7
Phosphoric Acid, available salts	3		100

J. G. ORTON, Chemist.

References:—Merchants' National Bank, Binghampton, N. Y.; Finch & Ross, Chauncey Waterman, Hon. R. A. Ford, G. A. Thayer, Mayor, Wm. E. Taylor and S. L. Scott, of Binghampton, N. Y.; Joseph Parsons, Whitney's Point.

Address P. O. Box 123, Binghampton, N. Y. Office 69 Court St. Binghampton, N. Y.

Comment is unnecessary. At the same figures of valuation our analysis shows a commercial value of $1.52 a ton; Prof. Genth's analysis $5.99 a ton. The selling price in New York is given as $30.00 a ton; in Pennsylvania as $35.00 a ton.

E. LEWIS STURTEVANT, DIRECTOR.

FODDER ANALYSES.

We present in tabular form all fodder analyses made during the year, and as they are of general interest, include many that have appeared in previous reports, these last, however, being designated by a star.

Labratory No.	GREEN FODDER.	Fresh Substances.						Dry Substance.				
		Water.	Ash.	Albu- min- oids. N ×6,25	Crude fiber.	Nitrogen free ex't.	Ether ex't. (fat).	Ash.	Albumin- oids.	Crude fiber.	Nitrogen free ex't.	Ether ex't.
37*	Soja hispida, plant, Sept. 19, 1882	69.35	2.36	3.94	8.91	14.39	1.05	7-71	12.75	29.06	47.05	3.43
50*	" " " Oct. 7, 1882	69.85	2.22	3.88	8.26	14.24	1.55	7.35	12.75	27.41	47.35	5.14
277*	" " " Sept. 16, 1883	70.41	2.58	2.20	7.93	16.01	.87	8.71	7.44	26.80	54.11	2.94
4*	Cow Pea plant, Aug. 14, 1882	86.03	1.89	3.25	2.87	5.34	.62	13.60	23.37	20.58	38.00	4.45
53*	" " " Oct. 7, 1882	82.10	1.77	3.00	4.09	8.46	.58	9.90	16.69	22.86	47.33	3.22
550*	Prickley Comfrey plant, 1884	86.14	2.56	3.25	2.00	5.68	.37	18.45	23.44	14.43	41.02	2.66
279*	Amber Cane plant, Sept, 29, 1883	75.04	.69	1.03	5.81	17.03	.40	2.77	4.13	23.26	68.22	1.62
557*	" " " Sept, 18, 1884	85.92	.73	1.06	6.56	5.34	.39	5.18	7.56	46.58	37.89	2.79
558*	" " " Sept. 18, 1884	86.38	.81	1.42	5.45	5.56	.38	5.94	10.42	40.02	40.84	2.78
5-9*	Waushakum Corn plant, average of 5 analyses, Aug. 18, 1882	86.05	.66	1.42	3.82	7.73	.32	4.76	10.30	27.44	55.23	2.27
11-15*	" " " " " " Aug. 25, 1882	84.38	.69	1.76	4.25	8.61	.31	4.46	11.32	27.27	54.98	1.97
18-22*	" " " " " " Sept. 1, 1882	81.81	.79	1.92	4.44	10.68	.36	4.37	10.51	24.56	58.58	1.98
24-28*	" " " " " " Sept. 8, 1882	77.34	.88	2.20	4.49	14.53	.55	3.88	9.71	19.82	64.14	2.45
30-34*	" " " " " " Sept. 15. 1882	75.01	.89	2.37	4.80	16.27	.65	3.58	9.50	19.25	65.07	2.60
38-42*	" " " " " " Sept. 23, 1882	69.67	.91	2.72	6.12	19.69	.89	2.98	8.95	20.17	64.96	2.94
542	" " " " " " Aug. 19, 1884	79.59	.72	1.70	4.77	12.69	.53	3.55	8.35	23.35	62.14	2.61
546	" " " " " " Aug. 20, 1884	80.62	.68	1.54	5.09	11.46	.61	3.52	7.94	26.28	59.13	3.13
246*	Husk Corn, plant, Aug. 9, 1883	81.97	.87	1.52	5.34	9.49	.81	4.81	8.44	29.63	52.67	4.45
258*	" " " Aug. 22, 1883	82.15	1.09	1.45	5.59	9.20	.52	6.12	8.13	31.32	51.55	2.88
547*	Minn. Dent Corn, plant, Aug. 21, 1884	82.21	.84	1.83	6.37	8.32	.43	4.72	10.31	35.78	46.76	2.43
544*	New England pop corn, plant, Aug. 20, 1884	87.43	.66	.94	4.47	6.16	.34	5.19	7.50	35.53	49.05	2.73
545*	Stowells Evergreen corn, plant, Aug. 20, 1884	80.48	1.00	1.72	6.14	10.14	-52	5.11	8.81	31.44	51.97	2.67
543*	Corn and Sorghum-plants, Aug. 19, 1884	82.41	.83	1.47	4.73	9.96	.60	4.70	8.38	26.91	56.60	3.41
23*	Silo Corn plant, Sept. 5, 1882	81.46	1.16	1.02	5.93	9.73	.70	6.26	5.50	31.99	52.48	3.78
81*	" " " Sept. , 1882	80.00	1.10	1.21	6.49	10.71	.49	5.48	6.06	32.45	53.55	2.46
186*	Corn Ensilage, Feb. 15, 1883	78.61	1.50	1.60	7.10	10.22	.97	6.99	7.50	33.20	47.78	4.53
200*	" " March 29, 1883	82.35	1.05	.87	5.87	8.72	1.14	5.95	4.94	33.27	49.38	6.46
356*	" " Jan. 25, 1884	84.58	.91	1.13	5.01	7.22	1.15	5.92	7.31	32.48	46.84	7.45
317*	Clover Ensilage, Dec. 22, 1883	------	------	------	------	------	----	9.35	10.75	40.80	34.03	5.07
216*	Alfalfa, 1883	75.01	2.15	4.07	8.68	9.45	.64	8.61	16-31	34.72	37.77	2.59
243*	Orchard grass aftermath, 1883	76.25	2.60	2.97	7.60	9.23	1.35	10.95	12.50	32.02	38.85	5.68
1843	Rowen mixed grasses	73.48	2.00	3.51	10.45	9.58	.98	7.55	13.25	39.40	36.12	3.68

Laboratory No.	HAYS.	Fresh Substance.						Dry Substance.				
		Water.	Ash.	Albuminoids. N ×6.25	Crude fiber.	Nitrogen free ex't.	Ether ex't. (fat).	Ash.	Albuminoids.	Crude fiber.	Nitrogen free ex't.	Ether ex't.
91*	Mixed grasses, crop of 1882	13.88	4.88	5.38	33.33	40.32	2.21	5.66	6.25	38.70	46.82	2.57
447*	" " " " 1883	15.22	4.94	5.14	31.28	41.36	2.06	5.83	6.06	36.89	48.79	2.43
870	" " " " 1884	18.00	4.54	5.74	32.19	26.88	2.65	5.54	7-00	39.26	44.97	3.23
1073	" " " " 1884	16.85	4.66	4.94	35.89	35.58	2.08	5.60	5.94	43.16	42.80	2.50
1381	" " " " 1884	12.97	5.22	7.02	34.35	38.17	2.27	6.00	8.06	39.47	43.86	2.61
1844	" " " " 1885	14.77	4.85	7.88	35.38	34.41	2.71	5.69	9.25	41.51	40.37	3.18
1845	Same hay as 1844, but exposed to the weather three weeks	------	------	------	------	------	----	4.10	7.50	53.41	32.83	2.16
1861	Same as 1844, exposed to the weather five weeks	------	------	------	------	------	----	3.88	5.81	56.02	32.50	1.79
789*	Clover Rowen, crop of 1884	14.13	6.16	10.36	29.38	36.88	3.09	7.17	12.06	34.22	42.95	3.60
553*	" " " " 1884	14.53	6.30	11.80	28.22	35.84	3.31	7.37	13.81	33.02	41.93	3.87
928	Same as 553, exposed to the weather one month—average sample	------	------	------	------	------	----	4.85	12.19	41.11	38.95	2.90
929	Same as 553, exposed to the weather one month—poorest sample	------	------	------	------	------	----	5.43	13.87	40.71	37.03	2.96

Laboratory No.	DRY FODDER.	Fresh Substance.						Dry Substance.				
		Water.	Ash.	Albumin-oids.	Crude fiber.	Nitrogen free ex't.	Ether ex't.	Ash.	Albumin-oids.	Crude fiber.	Nitrogen free ex't.	Ether ex't.
407*	Soja hispida fodder, Feb. 12, 1884	21.23	8.37	8.42	22.34	38.29	1.35	10.62	10.69	38.35	48.59	1.75
327*	Corn fodder, Jan. 21, 1884	56.49	2.71	3.40	15.46	20.64	1.30	6.23	7.81	35.54	47.44	2.98
1853	" " waushakum, 1885	51.52	3.78	3.51	19.18	20.90	1.11	7.80	7.23	39.57	43.11	2.29
1820	Fodder corn, orange flint, 1885	70.74	1.79	2.47	11.41	12.72	.87	6.12	8.37	39.01	43.52	2.98
	SEEDS.											
321*	Pearl pop corn, 1883	9.84	1.74	11.72	2.34	68.38	5.98	1.93	13.00	2.59	75.84	6.64
322*	Waushakum flint corn, 1883	11.91	1.38	11.12	1.91	68.66	5.02	1.57	12.62	2.17	77.95	5.69
323*	Eight-rowed sweet corn, 1883	10.10	1.66	10.10	2.44	67.56	8.14	1.85	11.25	2.72	75.12	9.06
324*	Minn. dent corn, 1883	12.61	1.45	8.62	2.31	70.67	4.34	1.66	9.87	2.65	80.85	4.97
325*	Tuscarora, Sept. 1883	7.17	1.41	8.82	1.59	75.50	5.51	1.52	9.50	1.71	81.33	5.94
326*	Frosted corn, 1883	16.07	1.73	11.12	2.33	65.17	3.58	2 07	13.25	2.78	77.64	4.26
859	Zuni, black, 1884	6.09	1.60	14.56	3.25	69.50	5.00	1.71	15.50	5.46	74.01	5.32
1374	Silver medal wheat, 1884	------	------	------	------	------	----	1.81	16.25	4.35	75.59	2.00
1860	Navy or pea bean, 1884	12.39	3.71	22.17	7.21	53.14	1.38	4.23	25.31	8.23	60.66	1.57

Laboratory No.	FEED.	Fresh Substance.						Dry Substance.				
		Water.	Ash.	Albuminoids. N ×6.25	Crude fiber.	Nitrogen free ex't.	Ether ex't.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free ex't.	Ether ex't.
90*	Corn meal, Jan. 2, 1883	19.98	1.18	8.65	.50	65.35	4.34	1.47	10.81	.63	81.67	5.42
251*	" " Aug. 11, 1883	12.84	1.15	7.52	.98	73.88	3.63	1.32	8.63	1.12	84.77	4.16
319*	" " Jan. 21, 1884	24.54	1.18	8.20	1.52	60.60	3.96	1.56	10.87	2.02	80.31	5.24
442*	" " Feb. 26, 1884	20.30	1.17	9.06	1.41	65.83	2.23	1.47	11.37	1.77	82.60	2.79
485*	" " March 13, 1884	21.00	1.29	8.02	1.74	64.62	2.33	1.63	11.43	2.20	81.79	2.95
1324	" " March 17, 1885	15.80	1.05	10.31	1.58	67.64	3.62	1.24	12.25	1.88	80.33	4.30
1801	" " June, 1885	10.25	1.36	9.08	1.18	73.55	4.58	1.51	10.12	1.31	81.96	5.10
1804	" " May, 1885	------	------	------	------	------	----	1.87	11.87	4.61	79.93	1.72
1869	" " 1885	12.88	1.38	9.90	2.81	68.87	4.16	1.58	11.37	3.22	79.05	4.78
1886	" " 1885	12.21	1.40	10.86	2.24	68.23	5.06	1.59	12.37	2.55	77.72	5.77
1887	" " 1885	8.01	1.38	9.55	2.14	73.95	4.97	1.50	10.38	2.33	80.38	5.41
1326	Ground oats, March, 1885	13.26	2.94	10.30	19.37	50.75	3.38	3.39	11.87	22.33	58.51	3.90
1803	" " June, 1885	10.09	3.24	11.63	16.57	53.98	4.49	3.60	12.94	18.43	60.04	4.99
1797	Pea meal, June, 1885	12.08	2.61	21.37	11.06	52.02	.86	2.97	24.31	12.58	59.16	.98

Laboratory No.	BY PRODUCTS USED AS FEED.	FRESH SUBSTANCE.						DRY SUBSTANCE.				
		Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free ex't.	Ether ex't. (fat).	Ash.	Albuminoids.	Crude fiber.	Nitrogen free ex,t.	Ether ex't.
88*	Wheat bran, Jan. 2, 1883	14.24	5.69	15.33	7.53	54.26	2.95	6.63	17.87	8.78	63.27	3.45
112*	“ “ Jan. 11, 1883	14.13	5.26	14.64	7.87	55.25	2.85	6.12	17.06	9.16	64.34	3.32
174*	“ “ Feb. 10, 1883	14.28	5.08	14 89	7.50	55.62	2.63	5.93	17.37	8.74	64.89	3.07
320*	“ “ Jan. 14, 1884	13.72	6.12	13.69	10.52	53.09	2.86	7.09	15.87	12.19	61.53	3.32
1325	“ “ March 17, 1885	15.83	5.43	13.99	13.14	50.11	1.50	6.45	16.62	15.61	59.54	1.78
1802	“ “ June, 1885	12.62	5.58	14.91	15.50	45.53	5.86	6.39	17.06	17.74	52.10	6.71
1872	“ “ 1885	13.36	5.26	13.81	14.82	50.38	2.37	6.07	15.94	17.10	58.15	2.74
1873	Middlings, 1885	13.77	3.65	12.45	4.42	60.83	4.88	4.23	14.44	5.13	70.54	5.66
1842	Shipstuff, 1885	16.00	6.32	14.96	4.77	53.86	4.09	7.52	17.81	5.68	64.12	4.87
1871	“ 1885	14.17	4.44	16.63	6.30	53.74	4.72	5.17	19.37	7.34	62.62	5.50
562*	Brewers grains, Sept. 24, 1884	74.98	.87	5.18	3.53	14.13	1.31	3.46	20.69	14.11	56.51	5 23
563*	“ “ Sept. 25, 1884	78.41	.76	4.27	3.05	11.67	.84	3.67	20.75	14.82	56.68	4.08
577*	“ “ Sept. 24, 1884	70.54	.98	4.44	4.09	12.60	1.35	4.17	18.94	17.44	53.69	5.76
578*	“ “ Oct. 1884	76.21	.96	4.83	4.38	12.21	1.41	4.05	20.31	18.40	51.31	5.93
687*	“ “ Oct. 1884	76.92	1.13	5.33	4.17	11.06	1.39	4.90	23.12	18.05	47.92	6.01
784*	“ “ Oct. 1884	75.57	.95	4.89	3.74	13.41	1.44	3.89	20.00	15.32	54.88	5.91
89*	Gluten meal, 1883	7.31	.74	28.03	.73	54.46	8.73	.80	30.25	.79	58.78	9.42
931	“ “ Feb. 6, 1885	16.50	.61	15.03	7.81	55.26	4.79	.73	18.00	9.35	66.18	5.74
1177	“ “ Feb. 21, 1885	12.29	.66	15.84	8.25	57.96	5.00	.76	18.06	9.41	66.07	5.70
1192	“ “ Feb. 24, 1885	9.00	.74	17.40	8.59	56.93	7.34	.81	19.12	9.44	62.56	8.07
1328	“ “ March 17, 1885	8.25	.86	30.16	2.78	52.79	5.16	.94	32.87	3.03	57.54	5.62
783	Starch refuse, wet feed, Oct 1884	68.51	.21	6.55	2.07	18.69	3.97	.65	20.81	6.58	59.34	12.62
900	“ “ “ “ Dec. 26, 1884	63.79	.23	7.70	3.29	20.72	4.27	.70	21.25	9.08	57.17	11.80
1048	“ “ “ “ Jan. 1885	63.60	.24	7.66	3.68	20.78	4.04	.65	21.06	10.10	57.08	11.11
1327	“ “ “ “ March, 1885	64.50	.21	4.61	3.75	24.93	2.00	.59	13.00	10.55	70.23	5.63
1428	“ “ “ “ April, 1885	65.50	.18	4.31	4.29	22.46	3.26	.51	12.50	12.43	65.11	9.45
1329	“ “ dry feed March, 1885	6.00	.72	16.04	13.02	58.14	6.08	.77	17.06	13.85	61.85	6.47
864*	Cotton seed meal, Jan., 1884	18.52	6.55	35.21	5.96	21.44	12.32	8.04	43.21	7.31	26.32	15.12
865*	Linseed meal, old process, 1884	8.07	5.33	31.71	12.31	34.38	8.20	5.79	34.50	13.39	37.40	8.92
866*	“ “ “ “ 1884	10.00	5.08	31.38	12.90	31.29	9.35	5.65	34.87	14.33	34.76	10.39
1798	“ “ “ “ 1885	9.43	5.24	32.03	11.06	35.71	6.53	5.79	35.37	12.21	39.42	7.21
1800	“ cake, “ “ 1885	10.04	5.10	28.73	12.41	33.47	10.25	5.67	31.94	13.80	37.20	11.39
867*	“ meal, new process, 1884	7.88	5.38	30.11	13.99	38.28	4.36	5.84	32.69	15.19	41.55	4.73
871*	“ “ “ “ 1884	8.55	5.07	32.35	13.77	38.13	2.13	5.54	35.37	15.06	41.70	2.33
1323	“ “ “ “ 1885	12.04	4.96	29.91	10.99	38.87	3.23	5.64	34.00	12.49	44.20	3.67
1799	Ground linseed, 1885	8.33	3.36	22.97	9.60	25.48	30.26	3.66	25.06	10.47	27.80	33.01
	ROOTS.											
1850	Carrot—Yellow Danvers, Oct. 1885	91.13	1.00	1.08	1.41	5.09	.29	11.31	12.19	15.93	57.35	3.22
1851	Mangold—Mammoth large red, 1885	94.41	1.09	1.03	1.00	2.40	.07	19.55	18.44	17.84	42.89	1.28
1846	Pumpkin	92.27	.63	1.11	1.49	4.34	.16	8.19	14.38	19.21	56.12	2.10

RECORDS OF SUNSHINE.

Since May 1st a daily record of the amount of sunshine received at the station has been kept by means of a sunshine recorder imported for this purpose. This instrument, manufactured by Negretti & Zambra, consists of a glass sphere which, acting as a burning glass, is made to produce a charred line upon a strip of prepared paper, suitably placed in the focus of the sun's rays. The paper is divided by lines at a distance apart representing hours, so that one may see at a glance the time of day, and the duration of any sunshine that may occur. This instrument fails to make any record for a considerable time after sunrise, and for about the same time before sunset, also whenever the atmosphere is smoky or slightly hazy, although the sun may not be obscured. This effect amounts to from 10—15 per cent. of the total sunshine.

In connection with the above, a record has been kept with an instrument constructed essentially upon the plan given in Nature, vol. 31, page 319. This consists of a silvered globe placed before a camera with a short focused lens, with the axis of the instrument placed parallel to the axis of the earth. In this position the sun's rays, reflected from the surface of the globe, form an image of the sun on a piece of sensitive paper in the camera. In consequence of the rotation of the earth, this image will describe the arc of a circle corresponding in length to the duration of the sunshine. By means of a circle divided into 24 parts, to represent hours, the amount of sunshine for any day is readily determined.

Instead of using the silvered globe, our instrument has been constructed by placing a small camera in the axis of the first mentioned instrument, so that the glass globe which forms its lens serves as a reflector for the latter. This has the advantage of making the results obtained by the two methods comparable, as they are always exposed to the same amount of sunshine.

The last described instrument is much more sensitive than the first, having shown throughout the season about 10 per cent. more sunshine than the first. This however, like the first, fails to make a record for a short time after sunrise and before sunset, but for a much shorter time. The sensitive paper used in the instrument is the same as is used by photographers for silver prints, and is well fitted for this purpose; but a more sensitive paper would no doubt give a record earlier in the morning and later in the evening.

The difference between the results obtained in these two ways gives some indication of the difference in intensity of the sunshine for different days.

In the tables given below appear the daily records for each instrument since May 1st. The record for each day is divided into four periods, the first including that part before 9 a. m., the next two being the three hour periods 9—12 and 12—3, and the last all after 3 p. m. The number of hours between sunrise and sunset for each day is also given. The totals for all are carried out for each month together with percentages of total sunlight. The results are interesting, as they show the distribution and amount of sunshine throughout the season.

It is hoped that the continuation of these records for several years, together with careful observations upon the growth of plants may show some relation between the amount of sunshine and plant development.

DATE.	Negretti and Zambra Instrument.					Photographic Method.					Hours sunrise to sunset.	
	Before 9 a.m.	9—12	12—3	After 3 p.m	Total	Before 9 a.m.	9—12	12—3	After 3.p.m	Total		
											hrs.	min.
May 1	0	0	0	0	0	0	0	0	0	0	14	6
" 2	2.30	3.00	3.00	2.30	11.00	3.15	3.00	3.00	3.15	12.30	14	8
" 3	3.00	3.00	3.00	1.00	10.00	3.00	3.00	3.00	3.15	12.15	14	11
" 4	0	.30	1.15	0	1.45	0	1.15	2.00	.15	3.30	14	13
" 5	0	0	0	0	0	0	0	0	0	0	14	15
" 6	0	0	0	0	0	.15	2.15	0	0	2.30	14	17
" 7	0	0	0	.15	.15	0	0	.15	1.45	2.00	14	20
" 8	0	0	1.30	2.30	4.00	0	1.15	2.30	2.15	6.00	14	22
" 9	1.00	0	0	.30	1.30	1.00	0	0	2.00	3.00	14	25
" 10	.15	.15	0	.15	.45	.15	.15	1.15	1.00	2.45	14	27
" 11	2.00	2.30	0	.15	4.45	2.00	2.30	0	.15	*4.45	14	29
" 12	3.15	2.45	1.00	.30	7.30	3.15	3.00	3.00	3.30	12.45	14	31
" 13	0	0	.30	30	1.00	0	0	.30	1.30	2.00	14	33
" 14	1.45	2.45	3.00	3.00	10.30	1.45	2.45	3.00	3.00	*10.30	14	35
" 15	3.00	3.00	3.00	3.00	12.00	3.00	3.00	3.00	3.00	*12.00	14	37
" 16	3.00	3.00	3.00	2.30	11.30	3.00	3.00	3.00	2.30	*11.30	14	39
" 17	3.00	3.00	3.00	2.30	11.30	3.00	3.00	3.00	2.30	*11.30	14	41
" 18	3.15	3.00	3.00	2.30	11.45	3.30	3.00	3.00	3.30	13.00	14	43
" 19	3.00	2.00	.15	.30	5.45	3.00	2.30	2.15	1.30	9.15	14	45
" 20	0	0	0	.30	.30	0	0	.30	2.00	2.30	14	47
" 21	2.00	3.00	3.00	3.00	11.00	2.00	3.00	3.00	3.00	11.00	14	49
" 22	0	0	0	0	0	1.00	.45	0	0	1.45	14	51
" 23	0	.30	1.00	1.30	3.00	0	.30	1.30	3.00	5.00	14	52
" 24	1.45	.30	1.00	0	3.15	3.30	2.00	2.15	0	7.45	14	54
" 25	1.15	3.00	1.30	.15	6.00	2.00	3.00	1.30	.30	7.00	14	56
" 26	3.30	1.30	.45	3.00	8.45	3.30	2.30	2.45	3.30	12.15	14	57
" 27	2.00	3.00	3.00	3.00	11.00	2.00	3.00	3.00	3.30	11.30	14	58
" 28	2.15	3.00	2.00	3.00	10.15	3.15	3.00	2.45	3.30	12.30	15	00
" 29	0	0	0	0	0	2.00	0	0	1.00	3.00	15	1
" 30	0	.45	2.45	1.15	4.45	0	1.00	3.00	2.00	6.00	15	3
" 31	0	.15	.15	.30	1.00	0	.30	.30	1.30	2.30	15	4
Total for May	41.45	44.15	40.45	38.15	165.00	49.30	53.00	53.30	58.30	214.30	453	29
Per cent. of possible sunshine	30.8	47.6	43.8	29.00	36.4	36.5	57.00	57.5	44.3	47.3		

*No record. The amount of sunshine taken the same as by the other instrument.

June 1	3.00	3.00	2.45	2.30	11.15	3.15	3.00	3.00	3.00	12.15	15	5
" 2	3.00	2.45	1.30	3.15	10.30	3.00	2.30	2.00	3.30	11.00	15	6
" 3	3.30	2.30	.15	.30	6.45	3.30	3.00	2.00	2.00	10.30	15	8
" 4	0	0	.30	0	.30	0	.15	.45	.15	1.15	15	9
" 5	0	0	2.30	3.15	5.45	0	0	2.45	4.00	6.45	15	9
" 6	3.45	3.00	2.30	1.30	10.45	4.00	3.00	2.45	2.30	12.15	15	10
" 7	.45	1.45	2.45	2.00	7.15	1.00	2.15	2.45	2.15	8.15	15	11
" 8	1.00	0	0	2.45	3.45	1.00	0	0	3.30	4.30	15	12
" 9	3.30	3.00	3.00	3.30	13.00	3.45	3.00	3.00	4.00	13.45	15	13
" 10	3.30	3.00	2.45	2.45	12.00	4.00	3.00	2.45	3.00	12.45	15	14
" 11	2.00	1.30	1.30	3.00	8.00	3.30	2.45	2.45	3.45	12.45	15	15
" 12	3.30	3.00	3.00	2.00	11.30	4.00	3.00	3.00	2.00	12.00	15	15
" 13	.30	2.00	2.00	0	4.30	1.15	2.00	2.00	1.00	6.15	15	16
" 14	3.20	3.00	3.00	3.20	13.00	3.20	3.00	3.00	4.00	13.30	15	16
" 15	2.30	.30	0	.15	3.15	3.00	1.00	0	.45	4.45	15	16
" 16	1.45	0	0	0	1.45	2.30	.15	.15	0	3.00	15	17
" 17	3.00	3.00	3.00	4.00	13.00	3.15	3.00	3.00	4.00	13.15	15	17
" 18	3.00	3.00	2.45	3.30	12.15	4.00	3.00	2.45	4.00	13.45	15	18
" 19	3.15	3.00	3.00	3.00	12.15	3.45	3.00	3.00	3.30	13.15	15	17
" 20	2.45	1.30	.30	0	4.45	3.20	3.00	2.30	0	9.00	15	17
" 21	1.00	1.30	2.00	2.15	6.45	1.15	1.30	2.30	2.15	7.30	15	17
" 22	.15	2.00	2.45	2.00	7.00	.15	2.00	3.00	2.00	7.15	15	17
" 23	3.20	3.00	3.00	3.30	13.00	4.00	3.00	3.00	4.15	14.15	15	17
" 24	3.00	3.00	3.00	2.45	11.45	3.30	3.00	3.00	3.30	13.00	15	17
" 25	1.30	2.15	.45	.45	5.05	2.00	3.00	2.00	1.15	8.15	15	17
" 26	3.30	2.45	2.30	3.30	12.15	4.00	2.45	2.45	4.00	13.30	15	16
" 27	3.30	1.30	.45	1.45	7.30	3.45	2.00	2.00	3.00	10.45	15	16
" 28	0	0	30.	0	.30	1.45	.30	.30	0	2.45	15	15
" 29	0	0	0	0	0	0	0	0	.15	.15	15	15
" 30	1.15	3 00	2.00	1.30	7.45	1.45	3.00	2.00	2.00	8.45	15	15
Total for June	63.15	58.30	54.30	59.15	237.30	78.00	64.45	64.45	73.30	281.00	457	03
Per cent. of possible sunshine	47.2	6.50	60.5	42.7	52.00	56.4	71.9	71.9	52.8	61.5		
Total since May 1	107.00	102.45	95.15	97.30	402.30	127.30	117.45	118.15	132.00	459.30	910	32

DATE.	Negretti and Zambra Instrument.					Photographic Method.					Hours sunrise to sunset.	
	Before 9 a.m.	9—12	12–3	After 3 p.m	Total	Before 9 a.m.	9—12	12—3	After 3 p.m	Total	hrs.	min.
July 1	3.30	3.00	3.00	3.15	12.45	4.00	3.00	3.00	4.00	14.00	15	13
" 2	1.30	.30	0	0	2.00	1.45	1.00	0	0	2.45	15	12
" 3	0	0	1.15	1.15	2.30	0	0	1.45	3.00	4.45	15	12
" 4	0	.30	1.45	1.00	3.15	0	.45	2.00	1.30	4.15	15	11
" 5	2.00	1.45	2.15	2.45	8.45	2.45	2.30	2.15	2.30	10.00	15	10
" 6	3.15	2.45	1.30	0	7.30	3.15	3.00	3.00	3.00	12.15	15	9
" 7	0	0	.45	2.30	3.15	0	0	1.00	4.00	5.00	15	8
" 8	3.30	2.45	1.30	4.00	11.45	4.00	2.45	2.00	3.45	12.30	15	7
" 9	2.00	2.00	3.00	1.30	8.30	3.00	2.30	3.00	1.30	10.00	15	6
" 10	2.45	1.30	2.30	3.30	10.15	2.30	1.30	2.30	3.30	10.00	15	5
" 11	2.45	3.00	3.00	3.30	12.15	3.00	3.00	3.00	4.15	13.15	15	4
" 12	3.45	3.00	3.00	3.15	13.00	4.00	3.00	3,00	4.00	14.00	15	3
" 13	0	0	.30	0	.30	0	0	1.15	.30	1.45	15	1
" 14	0	0	0	0	0	0	0	.45	.30	1.15	14	59
" 15	3.45	2.15	1.45	.30	8.15	4.00	3.00	2.00	1.15	10.15	14	58
" 16	.30	2.30	3.00	3.00	9.00	.30	2.45	3.00	3.00	9.15	14	56
" 17	4.00	1.45	3.00	3.30	12.15	3.00	2.45	2.45	4.00	12.30	14	55
" 18	2.45	2.30	2.45	3.00	11.00	3.00	2.45	2.45	4.00	12.30	14	54
" 19	3.45	3.00	3.00	2.30	12.15	4.00	3.00	3.00	2.30	12.30	14	52
" 20	2.30	2.30	2.15	2.00	9.15	3.00	2.30	2.30	3.30	11.30	14	50
" 21	1.45	.30	1.30	2.45	6.30	2.30	.45	2.00	3.30	8.45	14	48
" 22	.45	2.00	3.00	3.45	9.30	1.00	3.00	2.45	4.00	10.45	14	46
" 23	2.45	2,45	2.15	0	7.45	3.15	2.45	2.30	.30	9.00	14	45
" 24	0	.30	1.30	1.45	3.45	0	1.30	1.30	3.00	6.00	14	43
" 25	.30	.45	0	1.30	2.45	1.00	1.15	.30	2.30	5.15	14	41
" 26	0	0	0	.15	.15	0	0	.15	1.30	1.45	14	39
" 27	3.30	2.45	3.00	3.15	12.30	4.00	2.45	3.00	4.00	13.45	14	37
" 28	3.30	2.15	2.15	2.30	10.30	3.30	2.00	2.30	3.30	11.30	14	35
" 29	3.45	3.00	2.45	3.15	12.45	3.30	3.00	2.45	4.00	13.15	14	33
" 30	2.30	3.00	3.00	3.30	12.00	3.15	2.45	2.45	3.45	12.30	14	31
" 31	3.30	3.00	2.45	3.00	12.15	3.30	3.00	2.45	3.30	12.45	14	28
Total for July	64.45	55.45	61.45	66.30	284.45	71.15	62.30	67.45	88.00	289.30	462	11
Per cent. of possible sunshine	47.9	.60	66.4	47.2	53.8	52.7	67.2	78.2	62.4	62.6		
Total from May 1	171.45	158.30	157.00	164.00	651.15	198·45	180.15	186.00	220.00	785.00	1372	43
August 1	2.45	1.30	.30	2.00	6.45	3.15	2.00	2.00	3.30	10.45	14	26
" 2	.15	.45	2.45	2.45	6.30	.30	1.00	3.00	2.45	7.15	14	24
" 3	0	0	0	0	0	0	0	0	0	0	14	22
" 4	3.00	2.45	0	.45	6.30	3.00	2.45	.15	2.00	8.00	14	20
" 5	0	0	.15	2.15	2.30	0	0	.30	3.30	4.00	14	17
" 6	3.15	2.45	2.45	2.00	10.45	3.30	2.30	2.45	3.15	12.00	14	15
" 7	0	.15	.30	0	.45	0	.30	2.00	0	2.30	14	13
" 8	.45	.15	1.45	1.45	4.30	1.00	1.15	2.45	2.00	7.00	14	11
" 9	.30	.45	0	0	1.15	1.00	1.15	1.00	.30	3.45	14	8
" 10	0	0	0	1.30	1.30	0	0	0	2.30	2.30	14	6
" 11	2.45	2.45	2.15	3.00	10.45	3.00	2.45	2.30	3.45	12.00	14	3
" 12	1.00	1.45	.15	0	3.00	1.30	2.30	.30	0	4.30	14	1
" 13	1.00	0	0	.30	1.30	1.15	.30	0	1 00	2.45	13	59
" 14	2.00	2.15	1.15	1.00	6.30	2.00	2.15	1.30	1.30	7.15	13	55
" 15	2.15	2.45	2.45	3.15	11.00	2.45	2.45	2.45	3.45	12.00	13	53
" 16	2.30	2.45	2.30	3.15	11.00	3.30	2.45	2.30	4.00	12.45	13	50
" 17	2.45	2.45	2.30	.45	8.45	3.00	2.45	2.45	1.45	10,15	13	48
" 18	2.15	1.45	1.30	0	5.30	3.00	2.00	2.00	.30	7.30	13	45
" 19	1.15	1.45	2.00	1.30	6.30	2.00	2.00	2.45	2.00	8.45	13	43
" 20	2.00	1.00	.30	2.00	5.30	2.30	1.30	1.45	2.30	8.15	13	40
" 21	.45	0	0	0	.45	2.00	0	0	0	2.00	13	38
" 22	1.15	2.00	2.45	1.00	7.00	1.15	2.00	2.45	3.00	9.00	13	35
" 23	.15	0	0	0	.15	.30	0	0	0	.30	13	33
" 24	0	0	0	0	0	0	0	0	0	0	13	30
" 25	0	.15	0	.45	1.00	0	1.00	0	1.45	2.45	13	27
" 26	1.45	2.00	2.15	1.00	7.00	2.00	2.00	2.15	1.15	7.30	13	25
" 27	2.15	1.45	1.00	.15	5.15	2.45	2.00	2.00	1.00	7.45	13	22
" 28	.30	.30	2.15	.15	3.30	.30	.30	2.15	.15	3.30	13	19
" 29	2.00	3.00	2.45	1.45	9.30	2.00	3.00	3.00	3.00	11.00	13	16
" 30	1.15	2.45	2.30	2.00	8.30	1.30	2.45	2.30	2.30	9.15	13	13
" 31	2.45	2.00	2.15	2.45	9.45	3.00	2.00	2.15	2.45	10.00	13	10
Total for August	43.00	42.45	39.45	38.00	163.30	52.15	48.15	50.15	56.15	207.00	428	47
Per cent. of possible sunshine	36.00	46.00	42.7	30.8	38.1	43.7	51.9	54.00	45.6	48.3		
Total from May 1	214.45	201.15	196.45	202.00	814.45	251.00	228.30	236.15	276.15	992.00	1801	30

DATE.	Negretti and Zambra Instrument.					Photographic Method.					Hours sunrise to sunset.	
	Before 9a.m.	9—12	12—3	After 3 p.m	Total	Before 9a.m.	9—12	12—3	After 3 p.m	Total	hrs.	min.
September 1	2.00	.30	1.15	.45	4.30	2.00	1.15	1.15	2.00	6.30	13	8
“ 2	3.00	3.00	2.30	2.45	11.15	3.15	3.00	2.45	3.15	12.15	13	5
“ 3	2.45	3.00	2.00	.15	8.00	3.00	3.00	2.30	.15	8.45	13	2
“ 4	1.15	.15	0	0	1.30	1.45	.30	0	0	2.15	13	0
“ 5	0	0	0	2.15	2.15	0	0	0	2.15	2.15	12	57
“ 6	1.15	1.15	2.00	2.30	7.00	1.30	1.15	2.15	2.45	7.45	12	54
“ 7	0	1.15	1.30	1.30	4.15	0	1.15	1.15	2.00	4.30	12	51
“ 8	0	0	0	0	0	0	0	0	0	0	12	49
“ 9	1.45	.15	.30	0	2.30	1.45	.15	.30	0	2.30	12	46
“ 10	0	1.45	.15	1.45	3.45	0	2.00	.15	2.00	4.15	12	43
“ 11	1.30	2.30	2.45	2.30	9.15	1.30	2.45	2.45	2.45	9.45	12	40
“ 12	1.15	3.00	3.00	2.30	2.30	1.15	3.00	3.00	3.00	10.15	12	38
“ 13	1.15	1.15	1.15	.15	4.00	1.15	1.15	1.30	.45	4.45	12	35
“ 14	.15	1.15	3.00	2.30	7.00	.45	1.30	3.00	3.00	8.15	12	32
“ 15	2.30	3.00	3.00	2.30	11.00	2.45	3.00	3.00	3.00	11.45	12	28
“ 16	.15	.45	.30	1.45	3.15	,15	1.15	.30	2.15	4.15	12	26
“ 17	2.30	3.00	3.00	2.30	11.00	2.45	3,00	3.00	3.00	11.45	12	23
“ 18	0	0	.45	.45	1.30	0	0	1.00	1.45	2.45	12	20
“ 19	2.15	2.45	3.00	1.45	9.45	2.30	2.45	3.00	2.15	10.30	12	17
“ 20	2.30	3.00	3.00	2.45	11.15	2.45	3.00	3.00	3.00	11.45	12	14
“ 21	2.15	3.00	3.00	2.00	10.15	2.45	3.00	3.00	2.45	11.30	12	12
“ 22	2.15	2.45	.45	0	5.45	2.45	2.45	1.00	0	6.30	12	9
“ 23	0	1.00	.45	1.30	3.15	0	1.00	1.00	2.00	4.00	12	6
“ 24	1.00	2.15	2.45	1.00	7.00	1.00	2.15	2.45	2.15	8.15	12	3
“ 25	2.00	3.00	3.00	1.30	9.30	2.30	3.00	3.00	2.30	11.00	12	1
“ 26	2.00	3.00	3.00	2.00	10.00	2.45	3.00	3.00	2.45	11.30	11	58
“ 27	2.00	3.00	3.00	2.00	10.00	2.30	3.00	3.00	2.30	11.09	11	55
“ 28	2.00	3.00	3.00	2.00	10.00	2.30	3.00	3.00	2.30	11.00	11	51
“ 29	1.45	3.00	3.00	1.45	9.30	2.00	3.00	3.00	2.30	10.30	11	49
“ 30	1.45	3.00	2.30	1.30	8.45	2.00	3.00	2.30	2.00	9.30	11	46
Total for September	43.15	58.45	58.00	46.45	206.45	49.45	61.00	59.45	61.00	231.30	373	38
Per cent. of possible sunshine	43.5	65.3	64.4	49.6	55.3	50.00	67.8	66.4	63.7	62.00		
Total since May 1	258.00	260.00	254.45	248.45	1021.30	300.45	289.30	296.00	337.15	1223.30	2175	8

October 1	2.15	3.00	3.00	2.30	10.45	2.15	3.00	3.00	2.30	10.45	11	43
“ 2	0	.15	.15	.30	1.00	0	.30	.15	.30	1.15	11	40
“ 3	0	0	1.00	1.00	2.00	.15	.15	1.15	1.00	2.45	11	38
“ 4	0	0	0	2.30	2.30	0	0	0	2.30	2.30	11	35
“ 5	1.15	0	0	0	1.15	1.15	0	0	0	1.15	11	32
“ 6	0	1.00	0	.45	1.45	0	1.15	0	1.00	2.15	11	30
“ 7	2.15	3.00	3.00	2.45	11.00	2.15	3.00	3.00	2.30	10.45	11	27
“ 8	0	0	0	0	0	0	0	0	0	0	11	24
“ 9	0	1.30	1.30	2.30	5.30	0	1.30	1.30	2.30	5.30	11	21
“ 10	2.15	3.00	3.00	2.30	10.45	2.15	3.00	3.00	2.30	10.45	11	18
“ 11	2.15	2.30	2.00	1.00	7.45	2.15	2.30	2.15	1.00	8.00	11	15
“ 12	0	1.45	1.00	0	2.45	0	2.00	2.00	0	4.00	11	13
“ 13	0	0	0	0	0	0	0	0	0	0	11	10
“ 14	.45	0	0	0	.45	.45	0	0	0	.45	11	7
“ 15	0	1.15	2.45	1.15	5.15	0	1.15	2.45	1.00	5.00	11	4
“ 16	.45	2.45	2.15	.15	6.00	.45	2.45	2.15	.15	6.00	11	1
“ 17	2.00	3.00	3 00	2.15	10.15	2.00	3.00	3.00	2.00	10.00	10	58
“ 18	0	1.15	2.45	0	4.00	0	1.15	2.45	0	4.00	10	55
“ 19	0	1.00	0	0	1.00	0	1.30	.30	0	2.00	10	52
“ 20	0	0	.30	0	.30	0	0	.30	0	.30	10	50
“ 21	0	0	1.00	0	1.00	0	0	1 00	0	1.00	10	47
“ 22	0	.15	0	0	.15	0	.15	0	0	.15	10	45
“ 23	0	0	0	0	0	0	0	0	0	0	10	42
“ 24	1.45	2.00	3.00	2.30	9.15	1.45	2.00	2.45	2.00	8.30	10	36
“ 25	1.45	3 00	3.00	2.15	10.00	1.45	3.00	3.00	2.00	9.45	10	37
“ 26	1.30	3.00	3.00	1.45	9.15	1.15	3.00	3.00	1.45	9.00	10	34
“ 27	1.15	1.15	2.30	.30	5.30	1.00	1.15	2.30	1.00	5.45	10	32
“ 28	0	1.45	3.00	1.45	6.30	0	1.45	3.00	1.45	6.30	10	29
“ 29	0	0	0	0	0	0	0	0	0	0	10	26
“ 30	0	0	0	0	0	0	0	0	0	0	10	24
“ 31	0	2.45	3.00	2.15	8.00	0	2.45	3.00	2.00	7.45	10	21
Total for October	20.00	39.15	44.30	30.45	134.30	19.45	40.45	46.15	29.45	136.30	341	49
Per cent. of possible sunshine	25.7	42.2	47.8	39.5	39.3	25.4	43.8	49.7	38.2	39.9		
Total since May 1	287.00	299.15	299.15	279.30	1156.00	320,30	330.15	342.15	367.00	1360.00	2516	57

DATE.	Negretti and Zambra Instruments, Before 9 a.m.	9—12	12—3	After 3 p.m	Total.	Hours sunrise to sunset. hrs.	min.
November 1	.15	.15	0	0	.30	10	19
" 2	0	.30	.15	1.00	1.45	10	16
" 3	0	.30	0	0	.30	10	14
" 4	0	1.00	2.30	0	3.30	10	12
" 5	0	.15	0	0	.15	10	10
" 6	1.45	.30	0	0	2.15	10	8
" 7	0	0	0	0	0	10	5
" 8	0	0	0	0	0	10	2
" 9	0	0	0	0	0	10	00
" 10	0	1.30	3.00	2.15	6.45	9	57
" 11	0	0	2.00	1.30	3.30	9	55
" 12	0	.30	2.15	1.00	3.45	9	53
" 13	0	0	0	0	0	9	50
" 14	.30	2.00	2.45	0	5.15	9	48
" 15	.15	1.15	0	0	1.30	9	46
" 16	0	.15	0	0	.15	9	44
" 17	1.15	3.00	3.00	.45	8.00	9	42
" 18	0	0	0	0	0	9	39
" 19	0	0	0	0	0	9	38
" 20	1.30	1.30	1.15	.15	4.30	9	36
" 21	0	0	0	0	0	9	34
" 22	0	1.15	0	0	1.15	9	32
" 23	0	0	0	0	0	9	30
" 24	0	0	0	0	0	9	29
" 25	0	0	0	0	0	9	27
" 26	0	0	0	0	0	9	25
" 27	0	.15	2.00	.15	2.30	9	24
" 28	0	0	0	0	0	9	23
" 29	.45	1.00	.15	0	2.00	9	20
" 30	0	1.30	2.45	.45	3.00	9	19
Total for November	6.15	17.00	22.00	7.45	53.00	293	17
Per cent. of possible sunshine	11.00	19.00	24.7	13.7	18.1		
Total since May 1	284.15	316.15	321.15	287.15	1209.00	2810	14

						Possible sunshine	
December 1	0	.15	.15	0	.30	9	17
" 2	0	2.00	2.30	0	4.30	9	16
" 3	.15	.30	0	0	.45	9	15
" 4	0	0	0	0	0	9	14
" 5	.15	2.00	1.30	0	3.45	9	13
" 6	.15	1.00	1.15	0	2.30	9	11
" 7	.15	3.00	3.00	1.00	7.15	9	10
" 8	1.15	.30	0	0	1.45	9	10
" 9	0	0	1.15	1.15	2.30	9	9
" 10	0	0	0	0	0	9	8
" 11	0	0	1.00	0	1.00	9	7
" 12	0	0	.45	0	.45	9	6
" 13	0	0	0	0	0	9	6
" 14	0	0	0	0	0	9	6
" 15	0	1.15	.30	.30	2.15	9	6
" 16	0	1.15	1.00	0	1.15	9	5
" 17	0	1.15	0	0	1.15	9	5
" 18	0	.30	0	0	.30	9	5
" 19	0	0	0	0	0	9	4
" 20	0	1.00	.30	0	1.30	9	4
" 21	.30	1.45	1.00	0	3.15	9	4
" 22	0	0	0	0	0	9	4
" 23	0	0	0	0	0	9	4
" 24	0	0	0	0	0	9	5
" 25	0	0	0	0	0	9	5
" 26	1.15	3.00	3.00	.30	7.45	9	5
" 27	1.00	3.00	3.00	.30	7.30	9	6
" 28	0	0	0	0	0	9	6
" 29	0	0	0	0	0	9	7
" 30	0	0	0	0	0	9	7
" 31	0	0	0	0	0	9	8
Total for December	5.00	21.15	20.00	3.45	50.00	283	1
Per cent. of possible sunshine	9.00	22.8	21.5	8.2	17.6		
Total since May 1	289.15	337.30	341.15	291.00	1259.00	3093	15

Report of the Assistant Chemist.*

THE RELATIVE DIGESTIBILITY OF FEEDING STUFFS.

During the past year a few experiments have been performed to determine the relative digestibility of the albuminoids of some of our feeding-stuffs, also for comparing the relation of artificial with actual digestion, and to test the efficiency and ease of the following methods.

Stutzer's method† was the first used. This consists of using a digestion fluid prepared from a hog's stomach.

A digestion fluid was also used prepared from commercial scale pepsin.‡ The latter solution is less difficult to prepare, much easier of use, and with me gave more uniform results than did Stutzer's method.

The Pepsin method.

A muriatic acid solution of .2 per cent. strength was made and to each liter of this was added 5 grams of pepsin. Fresh solutions were made for each test.

The substance to be digested was thoroughly comminuted as for a chemical analysis. 1 or 2 grams were taken according to richness in nitrogen.

The substance to be examined was placed in an Erlenmeyer flask, and when the solution from a hog's stomach was used 250cc were taken, when the pepsin solution was used 150cc. Once in two hours 1 gram of HCl. was added until the solution contained .7 grams. The flasks were set in a water bath heated at from 38° to 42° C. for 14 hours; then allowed to cool down during the night and on the following day the heating was continued for six hours. They were then filtered, thoroughly washed with water until free from any traces of acid, then with alcohol, and the contents of the filter transferred to a nitrogen flask and dried at 100° C.

The nitrogen in the undigested residue was then determined by Kjeldahl's method.

In table I are given the analyses of the substances examined, water free, and table II and III contain the data obtained from the experiments.

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*E. F. Ladd.

†Journal für Landwirthschaft 1880 page 195; also Report of Maine State College 1883.

‡Manufactured by Henry Thayer & Co.

Notes on table I.

The first three hays were from the same lot. No. 1 as harvested, and in good condition. No. 2 was a sample of the same spread on the ground for one month, exposed to the weather and selected as an average of the lot. No. 3 was a sample of the poorest selected from No. 2 and was somewhat decayed.

No. 4. This hay was like No. 1 but gave slightly more nitrogen.

No. 5. A portion of No. 4 after having been prepared for analysis, then steamed.

No. 9. The Soja hispida was from the lot used in the digestion experiments noted in the 1884 report.

No. 10 was ensilaged fodder corn.

Nos. 13 and 15 were waste products from the American Glucose Co., and the same as used in the feeding experiments at the Station.

No. 14 was a similar product from the Glen Cove Starch Company.

Nos. 18 and 19 were selected as fair representatives of the old and new process linseed meal.

No. 24. The pea meal used in this was a sample from the meal fed the cows of Mr. Bronson during the butter test in June last.

The corn meals, raw, cooked and heated will be mentioned later.

TABLE No. I.

THE ANALYSES ARE FOR WATER FREE SUBSTANCES.

	HAY AND COARSE FODDER.	Albuminoids, N×6.25.	Crude fiber.	Nitrogen free extract.	Fat. Ether extract.	Ash.
1	Clover hay*	13.812	33.025	42.113	3.865	7.185
2	Same—exposed, average*	12.187	41.110	38.953	2.900	4.850
3	Same—exposed, poorest*	13.843	40.710	37.057	2.960	5.430
4	Clover hay*	14.531	-----	-----	3.86	------
5	Same, steamed*	14.343	-----	-----	3.41	------
6	Hay, ordinary mixed	5.94	36.89	48.91	2.43	5.83
7	Hay, poor quality many daisies	5.94	43.16	42.80	2.50	5.60
8	Fodder, corn	7.81	35.54	47.44	2.98	6.23
9	Soja hispida	10.69	28.35	48.59	1.75	10.62
10	Ensilage	7.31	32.48	46.84	7.45	5.92
	BY PRODUCTS.					
11	Wheat bran	15.87	12.19	61.53	3.32	7.09
12	Ship stuff	17.81	5.68	64.12	4.87	7.52
13	Gluten meal	32.87	3.03	57.54	5.62	.94
14	Starch refuse "wet feed"	21.06	10.10	57.08	11.11	.65
15	Starch feed "dry feed"	12.50	12.43	65.11	9.45	.51
16	Corn feed, ground germ	10.75	6.28	68.64	12.23	2.10
17	Corn feed, ground hull	7.50	14.12	68.76	8.02	1.60
18	Linseed meal, old process	34.50	13.39	37.40	8.92	5.79
19	Linseed meal, new process	35.37	15.06	41.70	2.33	5.54
20	Cotton seed meal	43.21	7.31	26.32	15.12	8.04
21	Same, cooked	42.73	-----	-----	-----	------
	GRAINS.					
22	Corn meal	12.37	2.55	77.78	5.77	1.59
23	Same, cooked	11.25	3.31	79.48	4.38	1.58
24	Pea meal	24.31	12.58	59.17	.97	2.97
25	Crushed oats	11.87	22.33	58.51	3.90	3.39
26	Corn meal	10.87	2.02	80.31	5.24	1.56
27	Corn meal	10.41	2.33	80.35	5.41	1.50
28	Same, cooked	9.87	2.47	82.39	3.85	1.42
29	Corn meal	12.25	1.88	80.33	4.30	1.24
30	Same, heated in bin	11.87	4.61	79.93	1.71	1.87
31	Wheat, Clawson's Winter	14.93	4.31	77.28	1.88	1.60
32	Bean, Navy or Pea	25.31	8.23	60.66	1.57	4.23

* See notes on table No. I.

TABLE No. II.

	DIGESTED BY FLUID FROM HOG'S STOMACH.	No. correspondi'g to No. of analyses.	Per cent. total Albuminoids. N×6.25.	Per cent. of digested albuminoids.	Per cent. of undigested albuminoids.	Per cent. of total albuminoids digested.
1	Clover hay	1	13.812	10.187	3.625	73.755
2	Same, exposed, average	2	12.187	5.995	6.197	49.232
3	Same, exposed, poorest	3	13.843	6.750	7.093	48.761
4	Corn meal	26	10.875	6.750	1.712	83.981
5	Ensilage	10	7.312	4.987	2.325	68.203

TABLE No. III.

Digested by Pepsin Solution.

	HAY AND COARSE FODDER.	No. correspondi'g to No. of analyses.	Per cent of total albuminoids. N×6.25.	Per cent of digested albuminoids.	Per cent of undigested albuminoids.	Per cent of total albuminoids digested.
6	Clover hay	4	14.531	9.831	4.700	67.655
7	Same, steamed	5	14.343	7.641	6.702	53.273
8	Hay, ordinary mixed	6	5.940	2.090	3.850	35.322
9	Hay, poor quality, many daisies	7	5.937	3.425	2.512	57.688
10	Fodder, corn	8	7.812	4.922	2.890	63.001
11	Soja hispida	9	10.687	8.109	2.578	75.920
12	Ensilage	10	7.312	4.486	2.826	61.351
	BY PRODUCTS.					
13	Wheat bran	11	15.875	13.219	2.656	83.269
14	Gluten meal	13	32.875	27.363	5.512	83.233
15	Starch refuse "wet feed"	14	21.062	15.456	5.606	73.435
16	Starch feed "dry feed"	15	12.500	7.606	4.894	60.800
17	Corn feed, ground germ	16	10.752	6.209	4.543	57.981
18	Corn feed, ground hull	17	7.501	5.220	2.281	69.711
19	Linseed meal, old process	18	34.500	30.884	3.616	89.518
20	Linseed meal, new process	19	35.375	27.750	7.625	78.445
21	Cotton seed meal	20	43.21	37.91	5.30	87.734
22	Same, cooked	21	42.73	31.54	11.19	73.812
23	Ship stuff	23	17.81	15.47	2.34	87.861
	GRAINS.					
24	Pea meal	24	24.312	21.562	2.750	88.689
25	Crushed oats	25	11.875	9.725	2.150	81.895
26	Corn meal	26	10.875	9.369	1.506	86.151
27	Corn meal	27	10.418	7.562	2.856	72.586
28	Same, cooked	28	9.875	6.236	3.637	63.169
29	Wheat, Clawson's Winter	31	14.93	13.00	1.93	87.073
30	Corn meal	29	12.25	8.68	3.57	70.857
31	Same heated in bin	30	11.81	8.23	3.58	69.789
32	Corn meal	22	12.37	8.50	3.87	68.63
33	Same, cooked	23	11.25	6.81	4.44	60.53
34	Bean, Navy or Pea	32	25.31	24.18	1.13	95.59

Of the feeds examined, in per cent of digestibility of the albuminoids, bean meal stands the highest, linseed meal, old process, next; pea meal but little less, while the mixed hay, of rather inferior quality but similar to much hay fed, stands lowest. The old process linseed meal shows a higher digestibility than the new process. This difference is due, very likely, to the partial cooking of the meal by steam during the process of oil extraction, and preparation of the meal for feed.

Cotton seed meal, much the richest substance examined, gives a high co-efficient for digestion. A notable difference exists between the first three hays, showing plainly the difference between well-cured hay and that exposed to the weather. Of raw and cooked meal, mention will be made further on.

In nearly every instance the determinations were made in duplicate. Tables II and III give only the average of the two determinations. In table IV are given a few of the duplicate tests to show how close parallels could be obtained. The greatest variation represents, as determined in nitrogen, a difference of less than one-tenth per cent.

TABLE No. IV.

	Per cent. of total albuminoids N×6.25.	Per cent. of digested albuminoids.		Per cent. of undigested albuminoids.		Per cent. of total albuminoids digested or digestion—co-efficient.	
		1	2	1	2	1	2
Pea meal	24.312	21.812	21.312	2.500	3.000	89.71	87.66
Linseed meal	24.500	31.032	30.750	3.468	3.750	89.94	89.11
Crushed oats	11.875	9.723	9.748	2.152	2.127	81.79	82.00
Hay	12.187	6.110	6.110	6.077	6.077	49.23	49.23
Fodder corn	7.812	5.000	4.844	2.812	2.968	64.00	63.00
Starch refuse	21.062	15.144	15.762	5.918	5.300	71.89	74.83

For digestion, a ration was prepared from samples of the same substances and in the same proportions as constituted the ration in period II of the digestion experiments previously performed at this station, the results of which were given in the report for 1884.

The following table gives the co-efficients of digestibility obtained for the ration, also as calculated for each constituent of it :

TABLE No. V.

	No. corresponding to No. of analyses.	Per cent. of total albuminoids N×6.25.	Per cent. of digested albuminoids.	Percent. of undigested albuminoids.	Per cent. of total albuminoids digested.
Ration	------	7.934	5.766	2.168	72.63
Ensilage in ration	10	7.312	5.369	1.943	73.56
Corn meal in ration	26	10.875	9.774	1.101	89.87
Wheat bran in ration	11	15.875	14.774	1.101	93.06

The digestion co-efficients obtained by the Pepsin method, are higher than those found with animals. Many reasons may be assigned for this variation, particularly with animals where there is greater liability to error and so many almost uncontrollable influences —the individuality of the animal, nervous influences, environments, temperature and the necessary compounding of a ration instead of a single feed,— enter in to vitiate the results. The errors incident to such experiments are entirely eliminated in the Pepsin method and uniformity secured for each test.

Further, the digestion co-efficients for ensilage, corn meal, and wheat bran, compounded in a ration and digested, were higher than were obtained where each was digested separately.

The following table gives this difference.

	Per cent. digested in ration. (Calculated)	Per cent. digested separately.
Ensilage	73.56	61.35
Corn meal	89.87	86.15
Wheat bran	93.06	83.26

The larger co-efficients obtained for these substances in the ration may be due to their greater digestibility when mixed together. This would not seem at all improbable in actual digestion, but with artificial solutions such would not have been expected. It is the only explanation we can offer at present, and without knowing whether the relation holds the same for each in the ration we can only calculate with certainty the digestibility of the ration.

In table I are given the analyses of the substances examined, water free, in table VI are given the same calculated to actual water content, or they may be considered as the pounds of each substance in 100 of the feed. This table taken in connection with table I makes the analyses complete, and the last column gives the number of pounds, in 100 of the feed, of digestible nitrogenous matter.

TABLE No. VI.

	HAY AND COARSE FODDER.	Moisture.	Albuminoids N×6.25.	Crude fiber.	Nitrogen, free extract.	Fat (Ether ex't.)	Ash.	Lbs. albuminoids digested in 100 lbs. of feed.
1	Clover hay	14.53	11.80	28.22	35.84	3.31	6.30	7.98
2	Same, exposed, average	14.53	10.42	35.14	33.28	2.48	4.15	5.13
3	Same, exposed, poorest	14.53	11.73	34.79	31.79	2.52	4.64	5.72
6	Hay, ordinary mixed	15.22	5.14	31.28	41.36	2.06	4.94	1.82
7	Hay, many daisies	16.85	4.94	35.89	35.58	2.08	4.66	2.85
8	Fodder, corn	56.49	3.40	15.46	20.64	1.30	2.71	2.14
9	Soja hispida	21.23	8.42	22.34	38.29	1.35	8.37	6.39
10	Ensilage	84.58	1.13	5.01	7.22	1.15	.91	.69
	BY PRODUCTS.							
11	Wheat bran	13.72	13.69	10.52	53.09	2.86	6.12	11.40
12	Ship stuff	16.00	14.96	4.71	53.86	4.09	6.32	12.73
13	Gluten meal	8.25	30.16	2.78	52.79	5.16	.86	25.10
14	Starch refuse "wet feed"	63.60	7.66	3.68	20.78	4.04	.24	5.60
15	Starch feed "dry feed"	65.50	4.31	4.29	22,46	3.26	.18	2.62
16	Corn feed (ground germ)	8.35	9.85	5.76	62.91	11.21	1.92	5.71
17	Corn feed (ground hull)	6.12	7.04	13.26	64.55	7.53	1.50	4.91
18	Linseed meal, old process	8.07	31.71	12.31	34.38	8.20	5.33	28.39
19	Linseed meal, new process	8.55	32.35	13.77	38.13	2.13	5.07	25.38
20	Cotton seed meal	18.52	35.21	5.74	21.66	12.32	6.55	30.89
21	Same, cooked	18.52	34.82	------	------	----	....	25.70
	GRAINS.							
22	Corn meal	12.21	10.86	2.24	68.23	5.06	1.40	7.45
23	Same, cooked	12.21	9.88	2.90	69.77	3.85	1.39	6.02
24	Pea meal	12.08	21.37	11.06	52.02	.86	2.61	18.95
25	Crushed oats	13.26	10.35	19.37	50.75	3.38	2.94	8.44
26	Corn meal	24.54	8.20	1.52	60.60	3.96	1.18	7.06
27	Corn meal	8.01	9.61	2.14	73.80	4.98	1.47	6.98
28	Same, cooked	8.01	9.09	2.27	75.80	3.52	1.31	5.74
29	Corn meal	15.80	10.31	1.58	67.64	3.62	1.05	7.31
30	Same, heated in bin	15.80	9.99	3.88	67.42	1.44	1.57	6.97
31	Wheat, Clawson's Winter	12.80	13.00	3.76	67.40	1.64	1.40	11.32
32	Bean, Navy or Pea	12.39	22.17	7.21	53.14	1.38	3.71	21.18

ALBUMINOID NITROGEN.

In most of the feeding stuffs examined, the albuminoid nitrogen has been determined by Stutzer's cupric-hydrate method.

The term amides is here applied to all that portion of the nitrogenous matter not true albuminoids.

The numbers before the substances are given to correspond with the numbers of the same substances in table I.

	Hay and coarse fodders.	Total Nitrogen.	Albuminoid nitrogen.	Amides.
1	Clover hay	2.200	1.605	.595
2	Same exposed, average	1.950	1.500	.450
3	Same exposed, poorest	2.215	1.810	.405
7	Hay, poor quality	.95	.87	.08
8	Fodder corn	1.25	.94	.31
9	Soja hispida	1.71	1.53	.18
10	Ensilage	1.17	.73	.44
	Bye products.			
20	Cotton seed meal	6.93	6.44	.49
18	Linseed meal, old process	5.52	5.30	.22
19	Linseed meal, new process	5.66	5.15	.51
15	Starch	2.08	2.11	.03
11	Wheat bran	2.54	2.08	.46
12	Ship stuff	2.85	2.37	.48
	Grains.			
32	Bean, Navy or Pea	4.05	3.53	.52
27	Corn meal	1.725	1.222	.503
28	Same cooked	1.580	1.217	.363
24	Pea meal	3.89	3.23	.66
29	Corn meal	1.96	1.41	.55
30	Same heated in bin	1.892	1.41	.482
31	Wheat, Clawson's winter	2.39	1.41	.98
22	Corn meal	1.975	1.505	.470
23	Same cooked	1.800	.831	.969
25	Crushed oats	1.90	1.65	.25
26	Corn meal	1.74	1.33	.41

Corn meal, Heated in bin.

In the early spring a quantity of fresh ground meal was put in a bin and an analysis made at the time, later it had become badly heated and somewhat mouldy, a second analysis was then made.

Below are given the analyses for both, water free.

	Fresh meal.	Heated meal.
Fat	4.30	1.71
Albuminoids	12.25	11.81
Crude fibre	1.88	4.51
Nitrogen free extract	80.33	80.00
Ash	1.24	1.87
Per cent. of nitrogenous matter digested	70.86	69.79

The apparent loss in fat is undoubtedly due to an oxidation, rendering the fat insoluble in ether, and nearly so in acid or alkali of the strength used for crude fibre determinations.

An examination of the nitrogenous matter gave the following:

	Total Nitrogen.	Albuminoid nitrogen.	Amides.
Corn meal	1.960	1.410	.550
Same, heated in bin	1.892	1.410	.482

To what extent oxidation may take place in the oil of corn is shown by a few experiments made for the purpose. The corn oil used was perfectly soluble in ether. 2.1014 and 2.5836 grams of oil were put in small fat flasks and kept at a temperature not exceeding 98° C. for a month and a half and frequently weighed. A few of the weights are given to show the gradual change in weight.

Aug. 7	2.1014 grams	2.5836 grams.
" 8	2.0982 "	2.5796 "
" 10	2.1106 "	2.5922 "
" 12	2.1616 "	2.6468 "
" 15	2.1702 "	2.6612 "
" 19	2.1764 "	2.6714 "
" 21	2.1752 "	2.6704 "
" 26	2.1702 "	2.6648 "
" 31	2.1602 "	2.6538 "
Sept. 5	2.1562 "	2.6484 "
" 11	2.1518 "	2.6440 "
" 18	2.1452 "	2.6368 "
Oct. 2	2.1388 "	2.6272 "
" 21	2.1328 "	2.6192 "

The loss in weight on Aug. 8 was probably due to moisture and volatile matter driven off. For 16 days the oil continued to increase in weight during which time it changed considerably in color, becoming darker and although perfectly fluid at the first it had now become firm in the flask and even when warm would not flow—a resin. At this stage it was but slightly soluble in ether, and nearly insoluble in acid or alkali of the strength used in fodder analyses for crude fiber. The increase in weight was in one case 3.73 per cent. in the other 3.56. After this there was a gradual diminution in weight by prolonged heating.

To further study this oxidation, Aug. 24, 22.6710 grams of corn meal from Stowell's Evergreen, on a watch glass was put in the drying oven and on the following day when the moisture had been driven off its weight was 20.2305 grams. It reached its maximum on Aug. 31, 20.2870 grams, and its minimum on Sept. 11, 20.134 grams. A determination of the ether soluble fat was made at the beginning of the test and again at the close.

Aug. 24,	7.72 per cent.
Sept. 18,	5.31 "

By prolonged drying of the meal the per cent. of fat soluble in ether was very materially decreased, and this oxidized fat is insoluble in alkalies of the strength used for crude fiber determinations.

Meal kept for a long time shows a similar oxidation in the fat, a smaller per cent. is soluble in ether, as the following shows :

Feb. 26, 1884,	2.79 per cent.
Aug. 6, 1885,	2.25 "

Feeds—Raw and Cooked.

In some carefully conducted feeding experiments, where the value of raw and cooked food has been compared, the evidence has been in favor of raw food for domestic animals.

Experiments at the Maine State College Farm* showed that it required 0.57 lbs. more of cooked than of raw corn meal to make a pound of pork.

A few experiments have been made with corn meal and hay to determine the difference between raw and cooked substances.

Two meals were examined, each in duplicate, one an old meal having lain in the bin three months, and the other a fresh ground meal quite different in appearance. The meals were thoroughly dried as for an analysis, and then divided into two portions. One portion was carefully analyzed and its digestibility tested, and the other was cooked by boiling, then dried and analyzed. During the process of cooking and drying, the old meal suffered a loss of 2.45 per cent. in weight, and the fresh ground meal 9.45.

The analyses are given for each meal, raw and cooked, calculated to bases of raw meal :

	Old meal.		Fresh meal.	
	Raw.	Cooked.	Raw.	Cooked.
Fat	5.41	3.85	5.77	4.38
Crude fibre	2.33	2.47	2.55	3.51
Total nitrogen	1.670	1.580	1.975	1.800
Albuminoid nitrogen	1.222	1.217	1.505	.831
Amides	.448	.363	.470	.969
Per ct. of nitrogenous matter digested	72.58	63.17	68.63	60.53

A partial examination of clover hay and cotton seed meal, raw and cooked, gave the following:

	Hay.		Cotton seed meal.	
	Fresh.	Steamed.	Raw.	Cooked.
Nitrogen	2.32	2.29	6.91	6.83
Fat	3.86	3.41	———	———
Per ct. of nitrogenous matter digested	67.65	53.27	87.73	73.81

In cooking there has been a change in the amount of ether soluble fat, probably not so much due to a loss or an oxidation, as to a surrounding of the fat by water soluble nitrogenous matter precipitated in cooking. Further there has been a loss in the corn meals, of the non-albuminoid nitrogenous matter—amides, which may have become broken up during the process.† The slight difference in nitrogen in fresh and steamed hay would not warrant the drawing of any positive conclusions, but leads us to think that the loss which takes place during the steaming is not so great as in the more concentrated feeds. We find the nitrogenous matter of cooked meal less digestible than in raw meal. In hay there was a difference of 14 per cent. in favor of the unsteamed.

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*Report of the College for 1876.

† Bied. Centr., 1885, 51--56.

PHOSPHORIC ACID.

The depth to which it may be carried in the soil:

To determine to what depth in a soil the phosphoric acid of a fertilizer might be washed, these experiments were undertaken.

The experiments were carried on in glass jars six inches in diameter and nine and one-half deep. These were filled with soil and covered with a perforated glass.

Water was supplied by means of a delivery flask. By this arrangement a known quantity could be supplied, the flow regulated and kept constant. A watch glass inverted beneath the falling water served to distribute it evenly over the surface. The soil used in the experiment was a clayey loam garden soil and contained .147 per cent. of P_2O_5, and as air dried 11.25 per cent. of moisture.

Experiment No. 1.

A jar was filled with this air dried soil, and 20 grams of Bowker's Alkaline phosphate mixed with the surface soil. None of the phosphate was allowed to come within three-fourths of an inch of the edge to prevent its being washed down in the space between the earth and glass. About ten pounds (4535 grams) of soil were used, containing 6.66 grams of P_2O_5, and the phosphate applied contained 2.66 grams.

Distilled water was added sufficiently slow, so that only at the end of 22 hours had the earth become saturated, having retained 925 cubic centimeters of water besides the 507cc. that it originally contained.

The first water to drain through contained phosphoric acid, and quantative tests showed the acid to be increasing as the washing advanced. After 2385 cubic centimeters had come through, the drainage water was saved until 4841cc. had been collected, and only traces of phosphoric acid were to be had. This drainage water was evaporated to a small quantity and the P_2O_5 determined, showing .1485 grams as the amount having been washed out of the earth, besides whatever amount may have been in the first 2385cc. of percolations.

3195cc. more of drainage water was collected and no traces of phosphoric acid were to be found. The supply of water was shut off for 36 hours and then again resumed when the drainage water gave phosphoric acid, but all traces soon ceased.

Distilled water charged with carbonic acid was then used, and after 1000cc. had passed through, phosphoric acid was again present and continued in marked quantities so long as carbonic acid water was used.

An analysis of the soil was then made. A sample from the surface gave .245 per cent. of P_2O_5; one from the center only .0002 per cent., while that from the bottom was too small for determination.

So quickly did the phosphoric acid come through in the drainage water in experiment No. 1, that I was led to pass water through a portion of the soil, to see whether phosphoric acid could be washed out of the soil itself. The result is given in experiment No. 2.

Experiment No. 2.

A small fiber flask was filled with earth like that used in experiment No. 1, and water run upon it. After a short time traces of phosphoric acid were found and continued in the drainage so long as water was passed through.

Experiment No. 3.

Another portion of the garden soil was thoroughly dried for several days. The moisture and such other volatile matter as was present must have been pretty largely driven off.

A second jar was filled with this. Nine pounds being used 11000cc. of distilled water was passed through and no traces of phosphoric acid found in the drainage.

Distilled water charged with carbonic acid was then used and soon traces of phosphoric acid were found in the drainage. When 1500cc. had been passed through, the supply was shut off for 36 hours, after which it was again resumed, and the first drainage to come through gave a heavy precipatate of phosphoric acid. 12000cc. of carbonic acid water was run through, and at this stage considerable acid was present, and continued so long as the experiment continued.

The result obtained in experiment No. 3 differs from those of Nos. 1 and 2; particularly No. 2, where we obtained phosphoric acid in the drainage water on passing distilled water through the soil.

We should bear in mind, however, that the soil, although of the same nature, was not treated under like conditions.

That in No. 2 was air dried and still contained a large per cent. of moisture while the portion used in experiment No. 3 had been thoroughly dried for several days.

We find also that when water charged with carbonic acid was used in experiment No. 3 phosphoric acid came through in the drainage.

In experiment No. 1, when $P_2 O_5$ had ceased to exist in the drainage, carbonic acid water again liberated it so long as the experiment was continued. In drying the soil, whatever change may have taken place, it was sufficient to drive off, or render nonactive, the agent which had previously forced the phosphoric acid from the soil into the drainage water. The supplying of distilled water charged with carbonic acid to this same soil gave us results agreeing with those obtained from soil that had not been so dried and containing 11.25 per cent. of moisture.

Experiment No. 4.

A third jar was filled with dry earth as in experiment No. 3. Spring water was supplied to this; 9000cc. of percolations gave no phosphoric acid. 50cc. of a solution made from Bowker's Alkaline phosphate was added to 1000cc. of spring water and allowed to flow slowly upon the surface of the soil. The above solution contained 2.01 grams of P_2O_5. After 3000cc. of water had been drained through phosphoric acid was present in the washings and continued during the experiment, when nearly 30000cc. more of spring water had passed through the soil.

An analysis of the soil was then made. A sample from the surface gave .0073 per cent. of P_2O_5; one from the center .00342 per cent., and from the bottom of the jar .00198 per cent.

Experiment No. 5.

Two small fiber flasks were filled with dry garden soil, being the same as that used in experiment No. 4.

Five grams of carbonate of lime was mixed with the soil of one and then to each was slowly added 250cc. of distilled water containing .2 grams P_2O_5.

The first drainage to come through gave phosphoric acid, and a much heavier precipitate was obtained from the one having carbonate of lime.

After a short time, however, the amount of phosphoric acid in the drainage coming from the soil containing carbonate of lime began to diminish while the other showed a marked increase.

On further washing with distilled water, the phosphoric acid nearly disappeared from the drainage coming from the earth containing carbonate of lime, while in the other its presence was very marked.

The last experiment would seem to indicate that while the ultimate tendency of carbonate of lime in a soil is to fix and retain any phosphoric acid applied to the soil, its first effect from the liberating of carbonic acid is to aid in washing away a portion of it, providing there be present sufficient percolating or moving water.

Fixation of Phosphoric Acid by a Soil from a Solution.

These experiments were made as preliminary to future investigations. To understand the results tabulated in the following tables a few explanatory notes may aid.

The soil used was a garden soil, the same as used in previous experiments, and was quite dry. Flasks were used to hold the substances. The contents were thoroughly shaken together, the flasks loosely corked to prevent the admission of any foreign matter and kept at temperature of laboratory, obscured from light.

In the last case, instead of adding the phosphate direct, a solution was made by shaking water and phosphate together, then filtering and adding enough of the solution to contain 1.608 grams of P_2O_5.

In the others, where phosphate was used, but 68 per cent. of the P_2O_5 (as given in column showing P_2O_5 added), was in a soluble form.

	Date of beginning experiment.	Amount of soil taken.	Bowker's Alkaline Phosphate.	Water added.	P_2O_5 in soil taken.	P_2O_5 added in phosphate.	Date of analyzing solution.	Per ct. of P_2O_5 in the solution.	Grams of P_2O_5 in solution when analyzed.	Per cent. of P_2O_5 added not fixed by soil.
	1884	Grams.	Grams.	cc.	Grams.	Grams.	1885.	Per ct.	Grams.	Per ct.
1	Dec. 27....	200	10	250	.294	1.329	Feb. 20....	.000394	.0985	7.411
2	" 29....	100	10	250	.147	1.329	" 20....	.000762	.1765	13.28
3	" 29....	100		250	.147	1.329	Jan. 12....	None.	0	0
4	" 29....	100	10	250	.147	1.329	Feb. 20....	.1176	.294	21.37
	1885									
5	Jan. 5....	100	10	250	.147	1.329	Feb. 20....	.0296	.074	18.40
6	" 5....	100		250	.147	1.608*	" 20....	1.638	.4095	25.46

* See remarks at beginning.

South Carolina Phosphate Rock.

A few experiments have been made with finely ground unacidulated Charleston phosphate rock.

The treatment was similar to the last experiments, save that drainage water from the plats was used in the three first, spring water in the fourth, and to the fifth was added 5cc. HCl.

Where no earth was used only traces of P_2O_5 were found, but when the water was slightly acidulated, though no earth was used, considerable P_2O_5 was rendered soluble.

	Date of beginning of experiment.	Amount of soil taken.	N. C. Ground phosphate rock.	Amount of water.	Date of analyzing solution.	Per ct. of P_2O_5 in the solution.	Grams of P_2O_5 in solution when analyzed.
	1885.	Grams.	Grams.	cc.	1885.		
1	May 18........		200	250	July 8........	Traces.	
2	" 18........	150	150	250	" 8........	.01176	.0294
3	Feb. 26........		200	250	May 16........	Traces.	
4	" 26........	150	150	250	" 16........	.0092	.0230
5	" 26........		200	250	" 16........	.034	.0850

Equal quantities, by measure, of the ground phosphate rock and wheat bran were thoroughly mixed together and kept moist and warm to induce fermentation. At the end of one week a sample was taken, dried and sifted to free from bran, and P_2O_5 determined. Less than .1 per cent. of soluble P_2O_5 was found.

Fermentation did not, in this case, render soluble much of the phosphoric acid of the ground rock.

Beans Grown in Soil with and without N. C. "Floats."

Two pots were filled with garden soil, and to one was added 75 grams of unacidulated ground phosphate rock. In each were grown two beans (yellow eyes), until they were just passing out of bloom, when they were examined. Below are tabulated the results :

	Soil.		Soil and N. C. "Floats."	
Weight of stalks as harvested	35	grams.	35	grams.
" " dry	6	"	7	"
Per cent. of ash	10.82	"	9.05	"
" P_2O_5 in ash	4.86	"	3.69	"
" " " dry plant	.5265	"	.3348	"

Water was supplied to each pot as needed by the growing plants. It is a singular coincidence that the beans, as harvested from the two pots, should weigh the same.

Further experiments are needed before making any generalizations, and discussion of results is reserved until other experiments are completed.

Report of the Farmer.*

Advantage has been taken of the wet season to destroy deep-rooting weeds, such as the Wild Parsnip, Wild Carrot, Burdock and Dock by hand pulling, with which many of the fields were infested. In the old apple orchard the weeds had such a foot-hold that it was deemed best to summer fallow, and seed to oats and grass in the spring. The younger apple-orchard received a dressing of about 200 lbs. of phosphate per acre in the spring, and the effect was apparently to increase the yield about twenty.five per cent.

The areas in farm crops were eleven acres of wheat, average yield by weight 40.63 bushels; seven acres of oats, average yield 61 bushels per acre for the White Russian and 44.5 bus. per acre for the Welcome; and ten acres of corn, the Topover yielding 42.96 bus. per acre, and the Waushakum 44.70 bushels of 80 lbs. ear corn to the bushel.

The Top Over is a new variety, and was to receive a farm test. It was therefore planted on a piece of wheat stubble, which had been seeded to clover, and where at the time of planting, May 4, the clover had a good growth. The four acres was staked out accurately in half acres, and each half acre received 250 lbs. of phosphate, spread as evenly as possible, and harrowed in with Thomas Smoothing harrow. The corn was planted May 21 and 22, in hills 3½ ft. apart, and was afterwards thinned to four stalks to the hill. The fields received frequent horse culture during the season, flat culture being strictly adhered to. The corn was cut and shooked Sept. 23, and husking commenced Oct. 27. The yield of each half acre was:

	Lbs. ear corn.	Bus. per acre.
1st half acre	1860	46.5
2nd " "	2060	51.5
3rd " "	1763	44.1
4th " "	1850	46.2
4th " "	1568	39.2
6th " "	1705	42.6
7th " "	1519	38.0
8th " "	1409	35.2
Average		42.9

A field trial was also made with oats in order to ascertain the influence of thick and thin seeding. The ground used was the corn stubble, plowed the preceding fall. In the spring the ground was thoroughly worked with the cultivator and harrow. Four half acres were then measured off and staked separately, leaving a space of one foot between each half acre as a guide in harvest White Russian oats were then drilled in, and the seeding and resultant crop are given below.

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*G. W. Churchill.

	Seeding, per half acre.	Yield per acre, Bus.
1st half acre	3 pecks	54
2nd " "	4 "	66
3rd " "	5 "	66
4th " "	2 "	58

Welcome oats were planted in the same field, seven pecks to the acre, and ripened about two weeks earlier than the White Russian, cutting commencing July 30. The straw of this variety was weak, and the field was badly lodged; the yield 44.5 bush. per acre. The White Russian on the four acres did not lodge, but stood upright until harvest, yielding 61 bus. per acre. Three acres in addition were broadcasted with White Russian. The field was west of and joined the one on which the reported tests were made, wheat stubble, spring plowed, and 200 lbs. of phosphate per acre. Two bushels of seed per acre was used, and the average yield was 40 bus. per acre.

On Sept. 17, 1884, eleven acres of Clawson wheat was put in on a summer fallowed field. The areas and fertilizer used, together with the crop are given below:—

Area.	Seeding.	Fertilizer,	Crop per acre.
3½ acres.	2 bus.	400 lbs. phosphate per acre.	42.57 bus.
4¾ "	2 bus.	295 " " " "	45.47 "
2¾ "	2 bus.	350 " land plaster "	29.81 "

Among the improvements of the year has been the extensive removal of old fences, the old pasture being added to the cultivated portion of the farm, other fields continued, and under direction of the Board of Control, a new pasture laid out on the west side of the farm, south of the orchard and including the ravine, fenced with about 1300 feet of Washburn & Moen's iron cement filled posts, and ribbon fence.

Upon the whole, our 1885 crops have been quite satisfactory, and much minutiæ work has been accomplished in the improvement of the farm, which now presents a better appearance than at any time since its occupation by the Station.

Reading of soil thermometer.

April-1885.	1 inch.			3 inches.			6 inches.			9 inches.			12 inches.			24 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 P. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
2	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
3	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
4	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
5	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
6	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
7	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
8	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
9	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
10	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
11	33	38	33.2	Mercury below surface.			33	33.5	33.7	32.7	32.7	32.7	32.5	32.5	32.7	33.7	33.7	33.7
12	33	37	36.3				32.7	33	35	32.5	32.5	33	32.5	32.5	32.5	33.7	33.7	33.7
13	33	39.5	34	------	36.2	------	33	34	34.7	32,5	32.7	33	32.5	32.5	32.5	33.7	33.7	33.7
14	30.5	35.5	36.5	Merc'y below surface.			32.5	32.5	35	32.5	32.5	33	32.5	32.5	32.5	33.7	33.7	33.7
15	32.5	34	37.5	------	------	37	32.7	32.7	35.2	32.5	32.5	33	32.5	32.5	32.5	33.7	34	34
16	33	52.2	44.7	------	44.5	45	33	36.5	42.2	32.7	33	35.2	32.5	32.7	33.5	34	34	34.2
17	33.5	56.5	49	------	47.7	49.5	34.2	39	46.2	34.5	34.2	39	33.2	33.5	36.5	34.5	34.7	35
18	36,5	56	50.7	------	48.7	51.5	36.5	41.7	48	37	38	43	37	37.2	40.7	35.7	36.2	36.5
19	38	61	54.2	37	53.3	53	37.7	45.5	49.5	39.2	41	44.5	39.5	40	42.5	37.5	37	38
20	44	65	62.5	41	55.7	59.5	41	47.5	54.5	41.5	42.7	48.2	41.7	42	45.7	39	39.5	39.7
21*	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
22	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
23	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
24	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
25	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
26	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
27	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
28	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
29	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
30	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

* Thermometers destroyed maliciously, and hence an interregnum until June 13.

Reading of soil thermometers.

June–1885.	1 inches.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1*	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
2	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
3	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
4	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
5	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
6	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
7	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
8	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
9	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
10	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
11	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
12	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
13	64.5	76.5	72	63.5	74	71	63	71	70.5	63	66.5	69	63	65.5	67	61.2	61.2	61.5
14	67.7	79.2	76.5	66.2	78	76	65	74.5	75	64.7	69	72	64.5	66.5	69	62.2	62.2	62.5
15	65.5	78.5	72.5	63	74.5	71.5	62.2	71	70.5	63	67.2	68.7	63.5	65.5	67	63.2	63	63
16	70.7	77.2	64.7	68	75	66.2	66.2	73	67	65.2	69	68	65	66.7	67	63.2	63	63.2
17	56.5	70	64.2	55.5	71.2	66	56	67.2	66.5	58.7	63	66	60.5	61.7	64.5	62.2	61.7	61.5
18	57	75.7	71.5	55.5	73	72	55.2	69.5	71	57.2	64	68.5	59	61.7	65.5	61	60.7	61
19	60	80.5	78	58.2	77.7	78	57.7	72.2	75.5	59.2	65.5	71.5	60.5	63.2	68	61.7	61.2	62
20	64	83.7	76	62.5	79.5	77	61.7	74.5	75	62.7	68	72	63.2	66	69	63	63.5	63
21	67	83.5	81	66	79.7	80.5	65.5	74	78.2	65.2	69	74.7	65	67	70.7	63.7	64	64
22	61.7	68	62	63	67	64.5	64	67	66	66.5	66	66.5	67	65.7	66.2	65	64.7	64.2
23	52	69	67	52.2	67.7	68	52	64.7	67.2	55.2	60.7	65.2	58	60	64	62.2	61.7	61.5
24	59	81	75	57	78	76	57	73	74.5	58.2	65.5	71	59.7	63	67.5	62	61	61.5
25	61	85.5	79	60	81.5	79.5	60	76	78	61	67.7	74	62	65.2	70	62.5	64	63
26	67.5	87	82.5	65.5	83	83	65	78.2	82	65.5	72	78	66	69	74	65.2	65	65.5
27	68	91	84	66.2	86	83.7	66	81	82.2	67.2	73	79	69	70.5	75	66.5	66.5	67
28	69	70.5	70.5	69.2	70.2	71.2	69.5	70	71.5	70	69.7	71	69.5	69	70	68.7	67	66.5
29	57	64	61.5	59	64	62.2	60.5	63.5	62.5	63.5	63.5	63.5	65	64	63.7	65.5	65	64.2
30	54.7	76	69.5	54.7	74.5	70	55.5	69.7	69.5	58	63.7	68	59.7	62	65.5	62.7	62.2	62.5

* Thermometers destroyed maliciously, and hence an interregnum until June 13.

Reading of soil thermometers.

July-1885.	1 inch.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	60.2	80.5	74.2	58.5	78.5	75.2	57.7	73.2	74.7	59.5	66	72	61	63.7	68.5	61.7	62.5	63
2	57.5	69	58.5	57.5	68	60.5	58.2	67	61.5	60.5	64	63	62	63	63	63.5	62.7	62.7
3	58.5	67.7	69.7	58.7	65.7	69.7	59	63.7	69	59.7	62.7	67.2	60.5	61.2	65	61.7	61.5	61.7
4	61	78	74	60.5	73.5	74.2	60.5	70	73.2	61	66	71.7	61.7	64	68	62	62	62.7
5	66.5	85	79.2	64.5	79.5	80	63.5	75.5	79.2	63.5	74.5	75.2	63.5	66.5	71.7	63.5	63.2	64
6	68.5	86	81	67	83.2	80.5	66	79.2	80	66.5	72.5	76.7	66.5	70	73.5	65.2	65	65.7
7	70	74.2	74.2	70	73.2	75.2	70	72	75.5	70	70.5	73.7	69.2	69.2	71.5	67	66.5	66.5
8	66	81	78.2	64.5	79	79	64	76	78.5	65	71	75.5	66	68.5	72.5	66	66	66.2
9	71.7	86.5	83.2	70.5	84.5	83.7	69.7	80.5	82.7	69.2	75	79.5	69	72	76	67	67	67.7
10	68	76.2	72.5	68.5	75.5	74	68.5	74	74.5	70	71.5	74	70.2	70.2	72.2	68.5	68	68
11	61.5	79.2	73.2	61.2	79	76	61.5	75	76.2	63.7	69.5	74.5	65.5	67.7	72	67	66.5	66.5
12	60	82	77.5	59	78.5	79	59	74.5	78.5	61.7	68	75.2	64	66	72	66.5	66	66.2
13	64.5	71.5	70.2	64	70.5	71	64	69.2	71.2	65.2	67.7	70.5	66.5	67	69	67	66.5	66.2
14	62.5	66	69.2	63	67	70	64.5	66.5	69.7	65	66	69	65.5	65.5	67.5	66	65.5	65.5
15	63.2	75.5	73.5	62.2	74	73.7	61.5	71.5	73.5	62.5	72.5	71.5	63.7	65.7	69.2	65	64.7	65
16	67	81.5	86.5	66.5	80	87	66	76.5	77.5	66.5	71	75.5	66.5	69	73	65.5	66.7	66.5
17	69.5	85	84.5	68.5	84.5	85.5	68	80	84	68.7	73.7	80	69	71.5	76	67.5	67.5	68.2
18	68.2	85.7	77	68.2	83.5	79.7	68.2	80	80	70	74.2	78.2	70.5	72	75.5	69	69	69.2
19	61.5	84.5	81	61.2	81.7	82	61.5	77.5	81.5	64.2	70.7	78.2	66.5	68.7	75	68.7	68	68.2
20	69.5	88	86	68.7	85.7	86.7	68.5	82	85.5	69.5	76	81.5	70	73	77.7	69	69	69.7
21	74	87	84	73.5	85.7	85	73	82	84	73.5	77.2	81	73.5	75	78	71	70.5	71
22	70.7	85.5	83.2	70.5	86.5	85.5	70.5	82.5	85.2	71.7	76.5	82.5	72.2	74	79	72.2	70.7	71.2
23	70.5	88.2	77.7	69.7	85.5	78.5	69.5	82.5	79	71	76.5	78.5	72	74	76.7	71.5	71	71.2
24	70	78.5	82	70	77.2	82.2	70.2	76	81.2	71.2	73.5	78.2	71.7	72.5	75.7	71	70.5	70.7
25	74.5	83.2	81.5	73.5	82	81.5	73	80	81	72.7	76	78.5	72.5	74	76.2	71	71	71
26	70.2	73.2	71	70	73	72.2	70	72.5	73	71	71.7	73	71.7	71.5	72.2	71	70.5	70.5
27	62.7	80.5	80.5	62	78.7	82.2	62	75.2	81.5	64.2	70.2	77	66.2	68.5	74.5	69	68.5	69
28	69.5	86	84	69	84	84.5	68.5	80.2	84	69.2	79.2	80.5	70	72.5	77.2	70	69.5	70.2
29	70.5	88	83.5	70.5	86	85.2	70.5	82.7	85.2	71.5	76.7	82,2	72	74	78.7	71	70.5	71.2
30	70	89.5	84.5	70	87.2	86.2	70.2	83.5	86.5	72	82.7	83.5	72.5	75	80	71.5	71.5	72
31	69.5	91.2	85	69.5	87.5	86.5	69.5	84	87	71.2	77.7	84	72.5	74.7	80.2	72.2	71.7	72.2

Reading of soil thermometers.

August—1885.	1 inch.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M,	6 P. M.
1	71.5	87.7	79.2	71.5	85.7	80.2	71.5	83	81	73	78.5	80	73.7	75.5	78	72.7	72.5	72.5
2	69	81	79.5	69	78.2	81.2	69.5	76	81.7	71	73.5	79.7	72	72.5	77	72	71.5	71.7
3	69	69	68	69.7	69.5	68.5	70.5	70	69	72	71	70.2	72.5	71.5	70.5	72	72	70.7
4	63.5	74	69	63.2	72.7	69.5	63.7	71.7	70	66	69.7	70	67.5	68.7	69.5	69.5	69	69
5	64.2	66.5	65.7	64.2	67	66.7	64.2	66.5	67.2	65.2	66.2	67.7	66.2	66.5	67.2	68	67.5	67.2
6	56.5	73.5	69	56.5	70.5	70	57	68	70.5	59.5	65	70	62	64	68.2	66	65.7	66
7	60.5	72	65.2	60.5	69	67.7	61	67.5	69	62.7	65.5	69	64	65	68	66	65.7	66
8	62.5	72.5	74	62.5	70.7	75.5	62.5	69	75.5	63.7	66.7	72.5	64.5	65.7	70	66	66.7	66
9	64.2	72.2	71.5	64.2	72.2	71.5	64.2	71.5	71.7	65.5	69.2	71	66.2	67.7	69.7	66.7	66.5	67
10	66.2	72.5	73.5	66	71.7	73.5	66	70.5	73	67	69	71.2	67	68	69.7	67	67	67
11	67.5	82.2	77.2	66.5	79	78.5	66.2	76.7	78.7	67	72.7	76.7	67.2	70	74	67	67.2	68
12	68.5	82.2	74	68	79.2	74.5	68	77.2	75	68.7	73.2	74	69	71	72.5	68.2	68.2	68.7
13	70.7	79.7	75.2	70.5	78	75.5	70.2	76.2	75.5	70.5	73.5	74.5	70.2	72	73	69	69	69.2
14	67.5	72.5	68.2	67.5	72	62.7	67.5	71.2	70.2	68.7	70.2	71	69.2	69.7	70.5	69.2	68.7	68.7
15	60.2	76	71.2	60.7	72	73.5	61.2	69.5	73.5	63.5	67.5	72.2	65	66.5	70.2	67.5	67	67.2
16	57.5	81	73.5	56.5	75	75.5	57.5	71	75	60.7	66.7	73	63.2	65.2	70	66.7	66.7	66.5
17	61.5	78.5	70.2	60.5	74.5	72.5	60.7	71.7	73	63	68	72.5	64.7	66.5	70.5	67	66.5	67
18	62.2	74.7	74	61	72	74	61.5	70	73.5	63.5	68	72	65	66.5	70	66.7	66.2	66.7
19	65	76.2	68.2	64	74	70.7	64.2	72	71.2	65.7	69.2	71.2	66.5	67.7	70	67	66.7	67
20	59.5	73.5	70.5	57.7	70.7	72	58.2	68	71.5	61	65.5	70	63	64.5	68	66.2	65.7	66
21	59.7	64	66.7	58.7	63.7	66.5	59.2	63.2	66	61.2	63.2	65.2	63	63.5	64.7	65.5	65	65
22	65.7	77	71.5	65.7	74.2	72.7	65.5	72	73	65.5	69	72	65.2	67	69.7	65	65.2	66
23	60.5	69	69	61	68	68.7	61.5	67.2	68.5	63.2	66	68	64.5	65.2	67	66	65.5	65.5
24	66.2	67.7	64.7	66	67.2	65.7	66	67	66	66.2	66.5	67	66.2	66.2	66.5	66	66	66
25	58	69.5	60	59.5	67.5	61.7	60.5	65.5	62.7	62.5	63.7	64	63.7	63.7	64.2	65.2	65	64.7
26	54.2	65	59	52.5	63.5	60	53	61.5	61	55.7	59.7	62	58.2	59.7	62	63.2	62.7	63
27	52.7	66	60	52	64	61.2	53	61.7	62	55.5	59.5	62.2	57.7	59.2	61.7	62	61.7	62
28	52.5	65	61	52.2	62.5	63	53	60.5	63.2	55.2	58.7	63	57.2	58.5	62	61.2	61	61.2
29	55.7	72	67	55.5	70.5	69	56	66.5	69	57.7	62.5	67.5	59	61	65	61.5	61.5	62
30	60	76.2	71.7	60	73.5	73.2	60.5	70	72.7	61.2	66	70.5	62	64	68.7	62.7	62.7	63.5
31	62	70.5	68.5	61	69.5	70.5	61.2	68	70	63	66	69	64	64.7	67	64.2	64	64.2

Reading of soil thermometers.

September 1885.	1 inch.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	59.5	69	61.7	58.5	67.2	64	59	65.5	65	61	64	65.2	62.5	63.2	64.5	64	63.7	63.7
2	51.7	71	65.2	50.7	68	67.2	52	63.7	67	55.5	61	65.5	58.2	59.7	63.5	63	62.2	62
3	52.7	71.7	68	52	69.7	68.2	53	65.7	68	55.7	61.2	66.2	58	60	64.5	62	61.5	62
4	55.5	66.7	56,5	56	66.2	58	57	64.5	59	59.2	62.5	60	60.7	61.5	61	62.2	62	62
5	54	59	59.7	54.7	58.5	60.7	55.5	58	60.5	57.2	58	60	58.5	58.5	59.7	61	61	60.7
6	49.5	64	60	48.5	62	62,2	50	59	62.5	53	57	62	55.5	57	60.5	60	59	59.7
7	52.5	65.7	64	52.2	63.7	65,2	53	61.7	65.2	55	59	64	56.5	58	62	60	59.7	60
8	54	61.5	59	53.7	60.2	59.5	54.5	59.5	59.7	56.5	58.5	60	58	58.5	59.5	60.2	60	60
9	62	67.5	60.7	60	66.5	62.5	59.7	64.7	63.2	59.7	62.7	64	59.7	61.2	62.7	60.2	60.2	61
10	52	67.2	59	52.5	66	60.7	53.7	63.2	61.2	56.2	59.5	61.5	58	58.7	60.7	60.5	60.2	60.2
11	54.2	65	60	54	64.2	62	54.5	62.5	62.7	56	60	62.5	57	59	62.7	60	59.7	60
12	64.2	67	64	64.5	66.2	65.7	55	64	65.5	56.5	60.5	64.2	57.5	59	63	60	60	60.5
13	60	72	71.5	59.5	71	71.5	59.5	68.2	70.5	60	64	68	60	62	65.5	60.7	60.7	61.2
14	65	75	68.2	64.2	74	71	69	71	71.5	64.7	67.2	70.2	64.2	65.5	78	63	63	63.5
15	62.2	73.2	67.5	61	73.5	71	61	70.5	70.5	62.5	66.5	69.5	63.2	64.7	67.5	64	63.5	63.5
16	57	64	59	57.5	63.2	61.2	58.7	62.2	62	60.5	61.7	62.2	62	62	62	63.5	63	61.7
17	63	68.7	64	52	69	66.7	53	65	67	51	61	66	58	59.7	63.7	61.5	61	61
18	57	66.5	65	57	63.7	66	57	62	65.5	58.2	60.5	64	59.5	60	62.5	61.5	61	61
19	53.5	71.7	67	53.2	70.7	69.2	54	66.7	68	56.5	61.7	67	58.2	60,2	64.5	61	60.7	61
20	50	68	62	49.5	68.2	65.7	52	64.7	66.5	55.7	60.5	65.5	58	59.5	63.5	61.2	60.7	60.5
21	51.7	69	65.7	51.5	68.5	67.5	52.2	65.5	67.5	55	60.7	65.7	56.7	59	63.2	60.5	60	60.2
22	57	73.5	59	56.5	71.2	59.5	57	68	63.2	58.5	63.5	64.2	59.5	61.5	63.2	60.7	60.7	61
23	45.2	49.5	45.5	47.5	50	47	49.7	51	50	53.7	53	52.7	56.5	55	54.5	60·2	59.5	58.7
24	47.5	59.2	57	47.2	57.2	58.5	47.7	55.5	59	49.5	53.7	58.2	51.5	52.5	57	57	56.5	57
25	48	64	61	48.5	64	63	49.5	61	63	52.5	57.2	61.7	54	56	59.7	57.2	57.2	57.7
26	54.5	73	69	54.2	72.2	70.7	54.7	67.7	70.2	56	61.7	67.5	57	59.5	64.2	58.2	58.5	59
27	56.5	76	70.7	56.7	74.7	73	57.5	70.2	72.7	59.2	64.5	70	60	62	66.7	60	60.2	61
28	56.2	75	70.2	56.5	74.5	73.2	57.5	70.5	73	59.5	65	70.5	60.7	62.5	67	61.2	61.2	61.7
29	56	73.7	70.2	56.5	73.2	72.2	57.7	69.7	72	60.2	64.7	70	61.5	63	67	62	61.7	62
30	58	76.7	70	59.7	75.7	72	59.7	71.5	72	61.5	66.2	70.2	62.5	64	67.5	62.5	62.5	63

Reading of soil thermometers.

October–1885.	1 inch.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	58.2	75.7	71	59	75	72.5	60	71	72.2	61.7	66	70.5	62.7	64.2	68	63	62.7	63
2	59	68	62	59.7	66.7	63.7	60.5	65	64.2	62.2	63.2	64.5	63	63	64	63.2	63	62.7
3	56.5	65.2	63.7	57	63.5	64.5	58	62.5	64	60	61.5	63.7	61	61	63	62.2	61.7	62
4	55.5	53.2	50.5	57	55.2	52.7	58	56.2	54.5	60	58.5	57	60.7	59.5	58.2	61.5	61.2	61
5	44.5	48.2	47	45.5	49.5	48	47	50.2	49	50.5	51.7	51.2	53.2	53	53	59	58	57.5
6	44	51	45.5	45.2	51.2	47.5	46.5	51.2	49	49.2	51	51	51.2	51.7	52	56.2	56	56
7	40.5	51	47	42	53.7	50.5	43.7	52.2	52	47	50.2	53.2	49.5	50.5	53	55	54.7	54.7
8	40	42.5	44	41	43	44.5	42.7	43.5	45.5	46	45.7	47	48.5	48	48.2	54	53.5	53
9	45	53.2	49.5	45	53.2	51.7	45.5	52	52.7	47	50	53	48.2	49.7	52	52.5	52.5	53
10	41	58.7	55	41.5	59	57	43	56	57.5	46	51.2	56.5	48	50.5	54.5	53	52.7	53
11	44	69	55.5	45	66.7	58	46	61.5	58.7	48.7	55.7	58	50.5	54.5	56	54	53.7	54
12	45	59	54	45.7	57	55	47	55.2	56	49.2	52 2	55.7	51	52	54.7	54.2	54	54
13	45.2	51.5	52.2	47	50.2	52.2	48.5	50	52.5	50.7	50.5	52.7	52	51.2	52.5	54.2	54	54
14	48.5	49.2	50.2	49.2	50	50.5	51.2	50.5	51	52	51.5	51.7	52.7	52	52	54	54	54
15	47	53	50.7	47.7	52.7	53	48.2	52	54	50	51.2	54.2	51	51.2	53.5	53.5	53.5	53.5
16	44	57.5	53	44.5	56.2	54.7	46	55.2	55.5	48.2	52.2	55.2	50	51.2	54	53.2	53.2	53.5
17	42.7	58.2	55.2	44	58.2	55.5	46	56.2	53	48	52.5	56	50	51.5	54.7	53.2	53.2	53.5
18	49	58	52	49	59.2	54	49.7	57	55	51	53.5	55.7	52	52.5	55	54	53.7	54
19	45	56	57	45	54.2	57	46	52.5	56.7	48.5	51	55	50	50.7	54	53.5	53.5	53.5
20	56.2	61.5	55	56	59.5	56	55.5	58	60	55	56.2	60	54.2	55.5	59	54.2	55	58
21	45	50	47	47	49	47.7	48	49.2	49.7	51	50.2	51.5	53	51.5	52	55	55	54
22	41	47	43.5	42	47	44.5	43.5	47	45.7	46.2	47	47.5	48.2	48.2	48.5	53	52.5	52
23	42	43.7	45	42.7	44	45.5	43.5	44.5	46	45.5	45.7	47	47	47	47.7	51.2	51	50.7
24	36.5	51.5	45.7	38	50.2	48	39.5	48	49	42.7	46	49.7	45	46	49	50	50	50
25	36	52.5	48.2	37.2	52.7	49.7	39	50.7	51	42.5	46.7	51	44.7	46.2	50	50	49.5	50
26	38	53.2	49	39.2	53	50.5	40.7	51	51	44	47.2	51	45.7	47	50	50	49.7	50
27	42.5	54	51.7	43	52.2	53	43.7	51	53.5	46	48.7	53	47.2	48.2	51.5	50	50	50.2
28	47.7	57.2	52	48	56.7	53.2	48.2	55	54	49.2	51.5	54	49.7	50.5	53	51	51.2	51.2
29	51.5	59.2	50	51.7	57.5	51.5	52	56	52.5	52.2	54	53.7	52.2	53	53.2	52 2	52.5	52.5
30	39.5	37.5	36.2	41.5	39.2	38.2	43.5	41	40	47	44.2	42	49	46.5	45.2	52	51.2	50.5
31	33.5	43	38	34.7	45.5	40.2	36	44	43	38.7	42	45	42.2	43	45	48.7	48.2	48

Reading of the maxima and minima thermometers, 7 A. M.

1885.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1	61	29	31	10	40	27.5	48	30	60.2	39	70.7	56.2	65.7	51.5	89	63	70.2	54	79	53	38.7	25.5	39	23
2	30.5	8	31.5	—4	39	21.5	44.5	25	44.5	32.5	67.5	47.5	69.2	48.7	85.5	64	67	44	78.2	55.5	45	30	35	23
3	10	2	6	—5.5	24	7	51	29	48	27.5	62.5	44	62.7	53.5	80	64	64	45.5	67	54.5	45	35	40	27
4	22	5.5	25.5	5	38	10	29	24	45	32.7	73.7	52.5	71.2	55	71.5	58.7	73.7	45	68.2	51.2	41	35	35	27.7
5	32	19	37.7	18.7	40	29	32.2	22	51.2	30	71	57.2	79.5	56.7	78	59	62.2	50.2	53.7	41	54.7	35	38	29
6	47	26	19.5	4	32	22	46	32	51	37.5	58.5	43.7	84	61.2	63.5	48.7	58	42.7	47.5	39	56.7	48	37.7	16
7	49.5	35	5.7	—4	27	15	37	28	69.5	48.7	71	54.5	83	68	79	53.2	63	46.5	47.7	35.5	63	48.7	25.2	7
8	39.5	32	27	—1	21	5	46	28	62	36.7	86.2	60	80.7	58	74.2	58.2	68.5	49	47	34.5	68	54	14.5	4.7
9	38.7	32.2	31	11	16	5.5	57	20.5	50	36	70.5	43	86.5	65.5	77	59.5	65	53	45	37	54	41	40	4
10	52	18.7	38	6	32	5	29	20.5	50	35	62.5	44	88	63.2	76.5	64.2	72	45.5	53.5	38.2	47	37	52	11
11	28.5	15	20	—11.5	18.7	1	38	26	46	35	70.5	46	73.7	54	74.2	60.5	58.7	45.5	64.2	40	47	36.2	36	26.2
12	49	22.7	—1	—12	19.5	1	37.7	30	48	28.7	77	49	70	46.5	82.5	63	62.5	50	66	37	58.2	38.5	29.5	21
13	50	17	20	—4	17.5	—11	35.5	30.7	63.5	37.2	85.7	58	77	56.7	85	67.5	69	53	61	39	68	49	31	21
14	18.5	9	14	—5	22.5	9	35.7	22	59	43.2	86.5	67	76	60	81.7	66.7	82	61	57.2	42	56.2	31	39.5	29
15	27	14	24.2	1	35.2	9	33.2	22.2	65.5	52	79.5	54.5	71	56	71.2	54.2	78	57.5	52	46	46	28.7	40	21
16	34	19.5	31	6.5	36	12	36	27.2	76	47	80	63.7	77.7	61.7	66.2	46.7	73.5	52	57.7	42	38	31	28.5	20.5
17	46	6	31	—10	20	1	44.7	27	79.2	50	77.5	49.5	80	66	74	54.2	60	46	62	40	39.5	31	33	25
18	31	11.5	7	—10	9.5	—5	51.2	31.5	81.7	49	65.5	47	90.5	61	79	56	66.2	49.7	67	40	44.5	30.5	35	28
19	18	2	16.5	2.5	21.5	3	58	31	79	47.7	75.5	51	72	48	81	59	71.7	50	59	38	49	37	40.5	32
20	12	—1.5	16	1	15	4	63	37.5	76	52.5	79.5	55	83.5	57.7	74.7	50.2	75.2	41.7	65	40	37.7	25.5	33.5	17
21	22.2	2.5	12	2.5	11.5	—2	72	47	68	50	83	62	89	68.2	70.2	53	52.7	42.7	71	40	38.7	25.5	26.5	17
22	11	—1	17.5	—3	11	—1	74.7	46.2	81.2	55	86	55	89	66	73.7	58.2	42	51.7	54.5	38.5	40	32	41.5	15.5
23	9.2	—2	18.5	0	18	2	81.5	50.5	71	57	62	41.5	83	61	74	56	78	41	47	38.7	42	30	47.5	28
24	25.2	1.5	19	0	20	6	84.5	55	74.7	55.5	67	51	88	68	70.5	59.2	50.5	40	45	34	35.2	28	53	26.5
25	36	21.7	21.5	1.5	37	11.5	75.7	39	76	58.2	76.5	51.5	87.5	70.5	66	53.5	64.2	44	51.5	32.2	35.5	27	28	15.5
26	33	13.5	24.5	2	24.5	12	49	36	78.5	55.5	80	58	82	66.5	62.7	45.5	66.7	45.5	56.7	33	35.7	27	24	13.5
27	15	—4	31	2	41.5	22	57.7	35.5	75.5	50.5	82.5	60	72	52.5	59	45	83.7	55	60	36.5	32.7	27	19	12
28	6.7	—2	34	22.5	48	27.7	57.5	34.7	69	45	85	65.5	81	61	59	45	80	53	62.5	44	35	18	32	13.5
29	5.2	—6	----	----	34	22	62	30	68.7	45	71.5	50.7	85	66.7	63.2	50	80.5	51	64	46.7	35.7	20.2	35	31
30	13.2	—3.2	----	----	31	22.2	51.7	32	68.5	47.5	57.7	50.5	82	64.2	67	53.5	79	52	61.2	33	36	27	34.5	22.5
31	31	12.5	----	----	41	27	----	----	72.5	42	----	----	85.5	60.5	76.7	56.2	----	----	34 5	25	----	----	42.5	27.5

Reading of the air thermometers.

1885.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	30	25	20	30	24.7	13	38.5	37.5	36	37	44	33.5	40	41	44	59.5	64.5	64	57.2	68.2	65.5	70	84	74.2	58	64	57	56	75.5	71.7	32	40.5	43	25	34	32
2	9.5	9	7.25	-5	2	.5	22.5	24	23	30	43	47	35.7	45.7	44.5	52.7	58.5	61	53.7	61	54	65	76	73.2	47.5	59.2	59	58	65	62	39	44.5	39	28	35.5	35.5
3	7	17.25	19.5	6	16.5	10.5	10.5	26.5	32.5	29.5	29	29	33.5	41.5	40	52.7	70.5	70	56.7	63.7	68.2	68.5	68	70	50.5	70	69	55.2	64.7	66	35.7	40.2	38	34	35	30.5
4	20	28	26.5	25	36.5	34	37.5	40	37	26	27.5	29	37	47	44.7	59.5	68.2	68.2	60.5	74	71	65	77.7	69.5	52.7	59	51.5	52.7	48.7	48	37	44.2	45	30	30.5	30.2
5	26.5	44	38.7	19	18.7	14.5	29	30	26.5	32.2	40.7	47	38	49	48.2	60.2	54	56.5	65.2	80	74.2	62	61	60	52.2	55	56.2	42	46.2	43	50	55	57	34.5	36.5	18
6	39	43	44	5	5	-2	23	25	22.5	34	34.2	36	49	59	68.5	55	67.5	67.5	68.5	81	80	53.7	64.7	62	47	58	55.2	39.7	44,7	40	49.2	61.5	59.5	18.5	23	23.5
7	39	36	34	1	12.7	10	16.5	21	15.5	33	42.5	41.5	55.2	56.5	52	62	80.2	78.2	70	73.7	75.5	59.2	72	62	51	62	61	37.7	44.5	39.7	59	68	62.5	9	13	12.5
8	33.5	36	37.5	27	22	22	12.5	16	12	45.5	35.5	29	37.2	44.2	49.5	69	55.5	53.5	66	84	83	61	70.2	74	53.7	62	59	38	42	45	54	52	44	6	16.2	20
9	38	49.7	36	21	25.5	32	7	23	28	22	26.5	26.2	45	39.5	44	46.2	57.2	60.5	77	84	82.2	65	71.5	74	64	64	54	44	49.5	46.7	42	46	42	39.5	47	50
10	19.5	20	15.5	20	11	4	15	17.2	15	26	36	36	36.2	43	45	54	67	67.5	65.2	71	70	67.5	71.7	72.5	47	56.7	54.7	40.5	61	52.5	38.5	42.5	39.5	33	32.2	30.2
11	28.5	33	37	-10	3.25	-3.5	2	9.5	17.5	30.5	38.5	32.5	38	45.7	45.5	53.2	73	68.7	59	68.5	65	67.5	80	74.5	51.7	62.7	58	43	65.2	49.5	40.2	44.7	49	27	26.7	25.2
12	49	38	29.5	-2.5	11.7	18	17.5	15	-1	32.7	34	34	37.5	58.2	56	58	79.5	80.2	56.5	73	75.2	68	84.2	74	54	65	63	39.7	57.5	54.5	58	64.7	57.7	22	25	27.5
13	17.5	18	14.5	2	9	7	-8.5	12	21	32	36	28.2	46	52.5	56.5	68	81.5	78.2	65	72	71	71.2	81	73.2	61	74	75	46	54	55	52.7	47	41	30	31.5	37.5
14	15	24	20.2	3	20.5	18.5	10.2	19.5	19	23	30.5	31.5	52	62.2	63.2	71	78	73	61	62	67	69	65.7	64	66	77	69.5	49.5	48.5	50	31.5	43.2	39.2	36.5	37.5	29.5
15	26.5	31	33	15	27	30	35.2	30	25	30.5	35	36	60.5	73.5	72	64.7	78.7	72	62	73.7	71.5	56.7	65	62	62	72.5	65	46.5	53.2	47.7	32	35	34.2	22	28	24.75
16	22	21.5	29	30	19	10	15	19.2	11.7	32	43.5	40.5	55	77	76	73.5	75.2	60.2	67	78	78	55	71.7	69	55	59	55	44	57.2	52	33	38.7	37	27	30.5	29
17	31	19.7	16.5	-8	1	2.5	2.5	7	3.2	32.5	49	46	59.5	77	76	55	62.2	63	74.7	88	87.7	60.5	74	67	50	62	61.5	41	61.7	57	31.5	47	40	28.5	34	34
18	13	15.2	9.5	4	14	6.5	4.2	16	18.5	36	53.7	53.7	56.5	75.2	75.7	56.2	72.5	71.5	64.5	71	65.5	62	75.5	76	58	67,2	64	49.5	57.5	48	44	47	47.2	33	40	36
19	4.25	11	4.7	5.5	14.5	8	12	14	10	37.5	60	59	59	73.2	64	60	75.7	77.5	57.5	77	75.2	64	71.5	66.2	52.7	73.7	64	41.5	59	62	37.2	35	32.5	33	32.2	26
20	4	18	16	3	11	7	5.5	11	2	48.5	68.7	69	54	60	67	62.5	80	77.5	68.7	84.5	84	56.7	67.7	66.5	45.7	59.7	53	60	69.5	54	26.5	38	33	19	21	22.5
21	12	10.2	9.5	6	16	12.5	.5	8.5	7	52	73.5	68.7	56.5	77.2	78	69.5	84	80	79	86.5	79	59.5	65.2	71	52	68.2	64.2	40	45	43	32.5	37.5	37.2	26	41	37
22	.2	5.5	9	-1	16	15.5	3.5	14	12	52.5	78.7	78	60.5	69.7	65.2	55	58.5	56	69	82	76.5	66	71.7	69	58.2	76.5	58.7	39.5	45.5	42	33.7	38	34	28.5	35.5	42.5
23	3	19.2	25.2	10.5	18.5	14.5	7	17.2	15.5	57.5	79.2	75.2	60	71	71.7	52	63.5	65	68,2	83.5	75	60	68.7	70	41.2	43.5	44	41.2	42	43.7	31.7	35.2	32.2	44	51	48
24	23	33	34.5	2	17	20.5	20	31.2	33.5	60	73.5	63	63	74.2	67.2	63	75	70	73	80.5	84.2	65	65	60.7	50.5	59.7	58.2	34.2	49.2	43	29	31	28.5	27	27.5	25
25	32.5	32	28.5	11	23	19.5	13	19.7	21	39.5	46.7	44	63	77.5	69.5	60	75.5	73	76	81.2	79.7	54	61.2	55	46	62.7	62.2	33.5	54	49	29.2	31.5	30.5	17	22	23.5
26	14.2	13.7	7	3	23.5	29	22.5	33	35.5	47	48	46	62.5	71	71.5	65.2	79.5	79	69	67.5	66	52	57.2	55	57.7	81.7	72	37.2	56.7	52	31	32	29	14.5	17	15
27	-2	4.5	4	26	32.5	31	39.5	46.5	41	47	56.5	49.7	61.2	68	65	69.5	84	81.5	61	75.5	76	49.2	57	54	56	78.2	70	44.7	57.5	51	28	31.5	24	14	24	29
28	4.5	1.5	-4	28	34	34	29.5	34	29	38	57.5	37.5	52	67.2	61	69	70	68.2	70.5	82	79.7	50.7	59.5	55	54	76.5	70.5	47.2	61	54	23	35	33	31.2	34	34
29	-2	8	8	----	----	----	23	30	29	33	45	49	58	65.5	58.7	51	52.5	57.7	70	79.7	78.5	53.2	64.2	64	52.5	75.7	72.5	52.5	61	45.5	31	34.7	34	32.5	32.5	30
30	13.2	29	25.2	----	----	----	29	38	39	51	59	54	50	61,7	67.5	53	64.5	63	69	83.2	79	59.7	74	65.5	56.5	77.5	68	34	31	30.5	29	36.7	31	28.5	34	40
31	16.2	22	17.5	----	----	----	34.7	41.2	45.5	----	----	----	58.5	62	61.5	----	----	----	68.5	88	79.2	60.5	64	63.2	----	----	----	30.5	36	30.5	----	----	----	37.5	39.5	37.5

APPENDIX.

OCT. 1.

INVENTORY.

STATION FURNITURE.

Stenographer's Room.

	No.	Value.
Bedstead	1	$6 00
Spring bed	1	2 50
Mattress	1	3 00
Dresser	1	12 00
Wash stand	1	4 00
Table	1	1 25
Chair	1	50

Botanist's Room.

Bedstead	1	$7 00
Husk mattress	1	3 50
Wool mattress	1	7 00
Bolster	1	2 00
Dresser	1	13 50
Washstand	1	4 50
Table	1	2 25
Book shelves	-----	8 00
Rocking chair	1	1 25
Chairs	2	2 50
Bowl	1	50
Pitcher	1	50
Soap dish	1	50
Chamber	1	75

First Assistant's Room.

Bedstead	1	$7 00
Spring bed	1	3 50
Mattress	1	3 00
Bureau	1	12 00
Table	1	2 00
Wash stand	1	3 00
Wooden arm chair	1	1 25
Chair	1	65

Director's Office.

Table	1	$2 25
Gas lamp	1	1 00
Spittoon	1	50
Wooden arm chairs with cushions	2	5 50
Tin post office box	1	1 00
Mail bag	1	1 00
Harvard stove	1	10 00
Dynamometer	1	30 00
Calipers, pair	1	1 00
Cricket clock	1	2 00
Mat	1	1 00
Floor mat	1	5 00
Step ladder	1	1 00

Stenographer's Office.

Table	1	$3 50
Wooden arm chair with cushion	1	2 75
Common chair	1	40

Public Office.

	No.	Value.
Cherry table	1	$80 00
Gas lamp	1	1 00
Cherry chairs	10	80 00
Cherry arm chairs	2	$24 00
Common chairs	2	80
Calendar clock	1	30 00
Spittoon	1	50
Waste basket	1	50
Mats	3	1 50
Two-light chandeliers	2	7 00

Entry.

One-light pendant lamps	2	$4 00
Water tank	1	1 00
Home-made hat racks	2	5 00

Laboratory.

Wooden arm chairs	3	$8 25
Stools	4	2 40
Step ladder	1	1 00
Desk table	1	25 00
Table	1	2 25

Piazza.

Settees	17	$68 00
Rubber mats	2	2 00

Men's Room.

Newark stove	1	$10 00
Table	1	2 25
Chairs	4	1 60

Miscellaneous.

Flag	1	$30 00
Cream pails	6	9 00
Large pan	1	1 00
Milk pails	6	3 10
Strainer	1	37

Stationery.

Bill blanks	600	$3 00
Blank books 9½ x 7 inches	11	6 60
“ “ 7 x 3 “	22	5 00
“ “ 8½ x 13 “	6	2 40
“ “ 8 x 5½ “	4	2 00
“ “ 6 x 3⅝ “	55	2 00
“ “ 12 x 9½ “	1	50
Bottles (mucilage)	4	1 00
Brushes	2	20
Blocks (drawing) 9 x 7 inches	4	1 40
Caligraph, rather worn	1	30 00
“ ribbons	10	7 50
“ stand	1	3 00
Copy-holder	1	1 50
Dotting pen	1	1 50
Envelopes 9 x 4 inches	400	80
“ 6 x 3 “	3,050	7 00
“ 6½ x 3¾ “	3,600	7 20
Gum labels (boxes)	11	11 00
Ink (quarts)	21	8 40
Inkstands	2	2 00
Lead pencils	130	2 00
Letter book (copying)	1	1 75
“ press	1	16 00

	No.	Value.
Letter heads 5½ x 8 inches	600	$3 00
" " 8½ x 11 "	600	3 00
Mucilage, quart	1	50
Pay roll blanks	300	3 09
Paper 8 x 10 inches, sheets	400	1 50
Paper (carbon) 8 x 10 inches, sheets	100	2 00
Paper (ruled) 8 x 10 in., shts	359	1 50
" " 10½ x 8¼ " "	500	2 00
" " 7½ x 6 " "	600	3 00
" " 12½ x 14 " "	100	3 00
" " 7½ x 6½ " "	350	1 00
" " 8½ x 11 " "	1,000	2 00
" (drawing) yards	15	2 25
" (wrapping) 40 x 30 inches, sheets	460	9 63
Paper fasteners, boxes	8	2 00
Pens (steel)	144	1 00
Penholders	12	35
Ribbon reels	1	75
Rubber bands, pound	1	1 00
Scratch blocks 5¾ x 7¼ in	18	1 50
" " 7½ x 5½ in	4	40
" " 5 x 6 in	88	3 00
" " 11 x 8½ in	2	20
" " 8½ x 10½ in	34	7 00
T squares	2	2 10
Tags (No 36)	4,500	18 00

Botanical Department.

Camera obscura	1	$10 00
Culture tubes (Salmon)	12	7 70
Dissection microscope (Bausch & Lomb)	1	12 00
Drying papers, sheets	340	3 40
Homogeneous 1-10 immersion objective	1	80 00

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Laboratory.

Articles.	No.	Value.
Acid dishes 5⅓ inches	2	$1 25
" jars graduated	2	2 25
" graduate glass 300cc	1	55
" " porcelain qt	1	55
Agate mortar 4 in	1	11 50
Adapters	5	1 00
Apparatus for C O2	1	4 00
Aspirator bottle, 2 gal	1	2 50
Analytical balance	1	50 00
Balance, druggist large	----	12 00
" small	----	7 00
Battery jars	4	1 60
Beakers, plain, 2 litre	1	50
" " 1 "	1	40
" " ½ "	3	1 20
" " ¼ "	7	2 35
" " 150cc	20	2 80
" " 100cc	2	16
" lipped, 500cc	2	75
" " 250cc	20	5 00
" " 200cc	4	60
" flasks, 500cc	6	2 10
" " 250cc	12	3 00
Bell glasses, 2 gal	11	22 00
" " 12 inch	2	4 00
" " 9 "	1	1 50
" " 6 "	6	5 00
" " 2 "	2	1 00
Bellows	1	$5 00
Blast lamp	1	5 00
Bottles, salt mouth glass stopper, qt	60	22 00
Bottles, salt mouth glass stopper, pt	157	45 50
Bottles, salt mouth glass stopper, ½ pt	34	8 50
Bottles, tinctures glass stopper, 2 gal	6	6 00
Bottles, tinctures glass stopper, 1 gal	6	2 25
Bottles, tinctures glass stopper, ½ gal	13	4 50
Bottles, tinctures glass stopper, 1 qt	10	2 50
Bottles, tinctures glass stopper, 1 pt	21	4 00
Bottles, tinctures glass stopper, ½ pt	33	5 50
Bottles, tinctures glass stopper, 4 oz	5	60
Bottles, tinctures glass stopper, 1 oz	1	10
Bottles, tinctures glass stopper, 2 qt. green	36	9 00
Bottles, salt mouth cork, 1 gal	13	2 50
" " " " 3 qt	9	1 75
" " " " 2 qt	11	2 00
" " " " 1 qt	12	2 00
" " " " 1 pt	82	12 00
" " " " 4 oz	57	7 50
" " " " 2 oz	28	2 25
" " " " 1 oz	12	1 00
" tinctures cork 2 qt	12	2 75
" " " 1 qt	6	1 50
" " " 1 pt	21	2 50
Brass tubes, 5 x 30 inch	6	9 00
Burette, 50cc	3	6 00
Burners, Bunsen	7	3 00
" " 3-burner	1	1 00
" solid flame, Fletcher's	2	3 00
" Fletcher's	2	2 00
Cans, tin	4	50
Carboys	5	5 00
Casserols	2	1 00
Centrifugal machine	1	5 00
Chloride of calcium jars	13	9 00
" " " tubes	4	75
" " " " for combustion	4	1 75
Churn (Cherry Test)	1	30 00
Clamps, large	2	2 00
Clamps, screw	4	2 00
Clothes pins	7	07
Clips for watch glasses	4	1 00
Combustion furnace	1	25 00
Condensers	1	2 00
Copper foil, lbs	4	2 00
Copper gauze	----	60
Corks, assorted	----	10 00
Cork borers	12	1 50
Cork press	1	1 00
Crucibles, porcelain	23	4 60
Crucible tongs	2	80
Cylinders, glass grad.. 100cc	2	2 00
" " 10 inch	2	80
" " 15 "	1	60
Dessicators	2	3 00
Developing dishes, porcelain	2	2 00
Diamond for marking	1	2 50
Diamond glaziers	1	5 00
Distilling apparatus, copper	1	2 00
Dropping bottles	2	1 25
Drying ovens, steam	1	30 00
" " 12 x 12	2	10 00
" " 5 x 8	1	2 00
Extraction apparatus	6	7 50
Eudiometer tube	1	1 50
Evaporators, glass	5	1 50
Evaporating dishes, 18 inch	1	4 00
" " 15 "	1	3 50
" " 12 "	1	2 00

Articles.	No.	Value.
Evaporating dishes, 9 inch	6	$4 00
“ “ 6 “	8	3 60
“ “ 5 “	7	2 45
“ “ 4 “	5	1 50
“ “ 3 “	8	2 00
Filter pumps, glass	2	2 50
“ “ brass	5	1 75
“ paper, coarse, ream	1	2 50
“ “ No. 597, quires	9	9 00
“ cut 40 cm	100	1 50
“ “ 15 “	200	80
“ “ 12 “	200	70
“ “ 11 “	1,600	4 70
“ “ 9 “	1,100	2 75
“ “ 7 “	1,700	3 40
Filter stands	2	1 90
Filter flasks	6	1 50
Flasks, flat bottom, 2 litre	6	1 50
“ “ “ 1 “	24	4 75
“ “ “ ⅓ “	9	1 25
“ “ “ 250cc	3	30
“ “ “ 200cc	34	2 75
“ “ “ 150cc	25	1 50
“ “ “ 190cc	40	2 00
Flasks, graduated 1,000cc	2	2 20
“ “ 500cc	2	1 90
“ “ 250cc	2	1 50
“ “ 200cc	2	1 30
“ “ 100cc	2	90
“ “ 50cc	1	40
“ “ 25cc	1	35
Forceps	2	90
Fiber bulbs	11	8 00
Fruit jars	18	90
Funnels, 1 gal	1	1 00
“ ½ gal	2	1 70
“ 1 qt	1	45
“ 1 pt	3	90
“ 3 inch	4	80
“ 2 inches	7	85
“ tubes	7	1 75
Gas machine	1	300 00
Gasoline, barrels	3	22 00
Gas bags, rubber	2	5 00
Glass tubing, lbs	20	15 00
Glass rod	3	1 50
Horn spoon	2	30
Horns coop	2	30
Horn spatulas	3	45
Hydrometers	4	4 00
Ink stand	1	25
Jars, museum, 2 gal	5	5 00
Jars, museum, 2 gal	1	2 00
“ “ quart	3	1 50
“ “ pint	3	1 00
“ Neslers	17	3 50
“ glass, 2 gal	6	10 00
“ for refuse, 5 gal	2	1 00
Kettle	1	50
Lactometers	1	60
Lactobutyrometers	1	7 00
Lamp, alchohol	1	2 00
Lamp, gas	1	1 00
Lamp, gas drop	1	2 00
Lamp wicks	30	30
Mercury trough	1	90
Mill, coffee	1	9 00
Mortars, porcelain, 9 inch	1	2 25
“ “ 3 “	2	1 00
“ iron	2	5 00
Mucilage bottle	1	10
Parchment paper. lbs	3	3 00
Pinch cocks	5	1 00
Plates	14	1 40
Photographic apparatus, including camera, 3 lenses, 6 plate holders, tripod, ruby lamp, printing press and case	----	35 00
Photographic plates, 4 x 5, doz	3	1 80
Pipettes, graduated 10cc	2	1 00
“ full 10cc	5	1 25
“ “ 100cc	1	70
“ “ 50cc	1	50
Pipetts, full 25cc	1	$0 40
“ “ 20cc	2	60
“ “ 5cc	2	40
“ “ 3cc	2	30
“ “ 2cc	2	30
Pipettes, sp. gr	3	60
Platinum dishes and crucibles gms	545	190 75
Platinum foil and wire, gms	57	19 95
Potash bulbs	2	1 20
Polariscope	1	90 00
Porous jars	4	1 20
Press	1	5 00
Refrigerators, home made	2	20 00
Retort holder	1	2 00
Retorts, 2 litre	5	3 75
“ 1 “	1	50
“ ½ “	4	1 50
Rubber stoppers, lbs	2	8 75
“ tubing, lbs	8	8 00
Sieves 1-100—1-10	10	5 00
Separatory funnels	2	1 60
Silver dish, 280 gms	1	28 00
Shears	1	10
Stand lamp	5	5 00
Spiral springs	3	75
Stove, oil	2	4 00
Step ladder	1	1 00
Support table	1	3 00
Soxhlett's milk apparatus	1	15 00
Sunshine recorder	1	50 00
Test tubes, 8 inch	12	75
“ “ 6 “	72	2 70
“ “ 5 “	72	2 10
“ “ 4 “	12	30
Test tube holder	1	40
Test tube brushes	7	35
Test tube racks	3	1 50
Triangles, iron	8	75
Thermometer, standard	1	12 00
“ chemical	9	9 00
“ common	16	50 00
“ recording	1	15 00
Tin foil, ½ lb	----	20
Towels, doz	1	1 00
Tripod, iron	1	50
Tables for fertilizer exp't	2	3 00
U tubes	8	2 00
Wates bath, copper, square	1	2 00
Water bath, copper, round	1	3 00
Weights, analytical	----	12 00
“ metric	----	6 00
“ avoirdupois	----	5 00
Watch glasses, 6 inch	5	2 25
“ “ 5 “	4	1 20
“ “ 4 “	16	3 20
“ “ 3 “	12	1 75
“ “ 2 “	25	2 00
“ “ perforated	6	2 00
Weighing flasks	2	50
Weighing tubes	2	40

Chemicals.

	Lbs.	Value.
Arsenic	2	20
Acid, citric	1¾	1 22
“ oxalic	1¼	81
“ boracic	4¼	1 50
“ carbolic	3	1 50
“ salicylic	1¾	3 00
“ galic	½	1 00
“ pyrogalic	¼	1 25
“ tartaric	1¾	1 00
“ molybdic	¾	3 75
“ fluorhydric	1	2 50
“ chlorhydric	6	1 50
“ sulphuric	9	2 43
“ nitric	14	4 20
“ acetic	5	1 00
Alcohol, 30 gallons	----	22 50
Alcohol, absolute	4	2 00
Asbestos	1	1 00

Articles.	Lbs.	Value.
Alum	3½	$0 50
Albumen	----	80
Ammonium nitrate	10	3 40
“ carbonate	½	27
“ oxalate	1	1 25
“ molybdate	⅛	75
“ chloride	1	50
“ bromide	1	55
Barium carbonate	2	80
“ chloride	1¾	35
‘ hydrate	1½	90
“ peroxide	¾	75
Benzol	1½	1 10
Borax	4	80
Bromine	1	4 00
Charcoal, animal	8	------
Copper, oxide	4	8 00
“ acetate	1	70
“ sulphate	2	80
Cobalt, nitrate	¼	1 25
Cochineal	⅛	09
Calcium chloride	3	90
“ carbonate	1	1 00
“ fluoride	4	40
Carbon, bisulphide	4	3 00
Chloroform	2	1 70
Citrate of iron and ammon	½	38
Emery	5	50
Ether	2	1 50
Gelatine	1	82
Glycerine	9	3 60
Guttapercha	¾	2 25
Glass wool	----	1 00
Glucose	3	30
Iron, powdered	3	1 50
“ alum	2	1 30
“ sulphate	2	16
“ chloride	1	44
“ sulphide	20	3 00
Indigo	¼	37
Indigotin, 1-4 oz	----	2 25
Iodine	¾	2 25
Lead acetate	1	60
Lead sub acetate sol	3	60
Lead chromate	2	3 50
Magnesium chloride	1½	------
“ calcinee	1	70
“ sulphate	¾	18
“ nitrate	----	75
Mercury	70	35 00
“ oxide	1	30
“ chloride	4	2 60
Manganese oxide	10	1 50
Platinum chloride sol	----	1 50
Potassium chromate	1	40
“ bichromate	3½	60
“ ferrocyanide	¾	81
“ ferricyanide	¾	1 50
“ carbonate	1	1 00
“ bromide	1	40
“ caustic	12	2 00
“ nitrate	3	30
“ cyanide	1	55
“ chlorate	4	88
“ iodide	¼	55
“ bisulphate	¾	75
“ permanganate	2	1 60
“ sulphide	2	60
Parafine	4	1 00
Rochelle salts	5	3 25
Silver,nitrate	⅛	1 75
Sulphur	10	50
Sodium, acetate	1	40
“ chloride	1	40
“ carbonate	2	80
“ bicarbonate	3	30
Sodium, nitrate	1	$0 12
“ nitrite	¾	1 00
“ phosphate	1	60
“ sulphite	1	25
“ lime	5	3 00
“ caustic	4	60
“ hyposulphite	1	10
Water glass	4	1 60
Zinc	8	1 60
“ dust	2	80
“ carbonate	1	30
“ oxide	1	15

Shop.

	No.	Value.
Anvil	1	$5 00
Alligator wrench	1	25
Arbor for holding saw	1	1 25
Bevel	1	50
Brad awl	1	10
Bench shears	1	3 00
Bick anvils	2	15 00
Bits, with brace, for wood	11	1 75
Chisels, for wood	8	1 50
Compasses	1	37
Crotch center	1	1 50
Chucks (for holding drills)	2	13 00
Countersink and reamer (for wood)	1	25
Draw knife	1	50
Drill rest	1	1 00
Forge (portable)	1	12 00
Files (for iron)	12	1 20
Gas plyers, pair	1	40
Gauges (for wood)	3	15
Gimlets	2	10
Hack saw	1	1 00
Hammers: 2 riveting, 2 nailing, 3 sledge and 1 babbit metal	7	7 00
Inside calipers (6 inch), pair	1	50
Level	1	75
Lathe (back geared screw cutting)	1	100 00
Lathe dog	1	50
Melting ladle	1	25
Mitre square	1	1 00
Nippers (cutting)	1	75
Oil can	1	20
Oil stone	1	37
Pinchers (flat nosed)	3	1 25
“ (round nose)	2	
Planes	2	1 00
Rasps (for wood)	4	50
Spur center	1	1 00
Steel center square	1	2 00
Screw drivers (one handle)	4	75
Saws, rip and cross cut	2	2 75
Stencil	1	1 50
Soldering irons	3	90
Square (large)	1	1 25
Saw, back	1	75
Turning tools (for wood)	10	3 00
Tongs, pair	1	75
Twist drills	34	4 00
Try square	1	20
Turning tools for metal	8	2 00
“ “ “ brass	19	4 00
Vise	1	5 00
Vise	1	3 00
Wrenches. monkey	3	1 20
Washer cutter	1	45
Wing calipers, 8 inch, pair	1	75
Wire gauge	1	1 25
Wire cutter	1	2 00

FIFTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

New York Agricultural Experiment Station.

(GENEVA, ONTARIO CO.)

For the Year 1886,

WITH REPORTS OF THE DIRECTOR AND OFFICERS.

TRANSMITTED TO THE LEGISLATURE JANUARY, 1887.

IBRARY OF
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TORY OF NATURAL HISTORY,
URBANA, ILLINOIS.

ELMIRA, N. Y.:
ADVERTISER ASSOCIATION PRINT.
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1886.

ORGANIZATION OF THE STATION.

BOARD OF CONTROL.

GOVERNOR HILL, Albany, N. Y.
ROBERT J. SWAN, President, Geneva, Ontario Co., N. Y.
GEN. N. M. CURTIS, Sec., Ogdensburg, St. Lawrence Co., N. Y.
PATRICK BARRY, Rochester, Monroe Co., N. Y.
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STATION OFFICERS.

Director,
E. Lewis Sturtevant, A. M., M. D.

First Assistant,
C. S. Plumb, B. S.

Horticulturist,
Emmett S. Goff.

Assistant Horticulturist,
M H. Beckwith.

Botanist,
J. C. Arthur, D. Sc.

Chemist,
S. Moulton Babcock, A. M. Ph. D.

Assistant Chemist,
E. F. Ladd, B. S.

Stenographer,
F. E. Newton.

Farmer,
G. W. Churchill.

Location of Station: Geneva, Ontario Co., N. Y.

REPORT OF THE BOARD OF CONTROL

OF THE

N. Y. AGRICULTURAL EXPERIMENT STATION.

To the Honorable the Legislature of the State of New York:

I herewith respectfully submit, in behalf of the Board of Control, the Fifth Annual Report of the New York Agricultural Experiment Station. Its contents will explain the success which is now rewarding our efforts; and this, with the Report of the Treasurer, render unnecessary any extended remarks on my part.

Respectfully submitted,

ROBT. J. SWAN,

President.

Treasurer's Report.

GENEVA, N. Y., Oct. 1, 1886.

To the Board of Control of the New York Agricultural Experiment Station:

As treasurer of the Board of Control, I do respectfully report :

That I have received from the Treasurer of the State of New York for the twelve months ending Sept. 30, 1886	$ 20,000.00
That the balance on hand Oct. 1, 1885, was	2,764.35
Total	22,764.35

And I do further report that I have expended during the twelve months ending Sept. 30, 1886, the sum of $22,025.79, vouchers for which, duly audited by the Special Auditing Committee of the Board of Control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows :

Board of Control	$ 599.32
Botanical department	38.92
Farm	73.50
Farm implements and tools	271.97
Freight, cartage and express	187.39
Fuel	409.75
Labor	4,668.79
Laboratory department	620.96
Library	160.35
Manure and fertilizer	191.90
Meteorological department	7.30
Permanent improvement	1,724.84
Postage expenses	163.15
Printing	899.28
Repairs	818.05
Salaries	9,387.86
Scientific apparatus	15.00
Stationery	84.92
Sundries	124.77
Supplies	1,177,34
Travel	400.43
Total expenditures	22,025.79
Balance on hand	738.56
	22,764.35

And I do further report that I have received from sales the sum of $115.03. which sum has been duly paid to the Treasurer of the State of New York.

WM. SLOSSON,
Treasurer.

Report of the Director.

To the Board of Control of the New York Agricultural Experiment Station.

Gentlemen:—I herewith submit my fifth annual report, for the calendar year 1886.

The peculiarity of the year 1886 was the high temperature of March and April; this warmed the soil so that growth towards earliness was superior in 1886, for spring and early summer plants, to what the air temperature of May and June would seem to warrant. As we have no records of the soil temperature during the most of April, 1885, and none for May, we can but compare the soil temperatures for a short period, viz: from April 11–20, for the two seasons; thus for these dates:

			Mean temp. of soil.
1 in. depth,	1885,	April 11-20	42.0°
1 in. "	1886,	"	56.6
9 in. "	1885,	"	35.8
9 in. "	1886,	"	50.3

The mean air temperatures, however, abundantly evidence the connection of previous temperatures with the earliness of early summer growth. The mean temperatures, as given below, are the observations of 7 A. M., noon, and twice the 6 P. M. divided by 4.

		March.	April.	May.	June.
Av. max. temp.	1885	27.1°	50.7°	64.7°	74.1°
" " "	1886	37.0	60.1	65.7	75.1
Av. min. temp.	1885	10.3	31.6	44.0	53.0
" " "	1886	23.4	37.8	45.7	53.2
Mean temp.	1885	21.1	43.8	58.0	66.9
" "	1886	32.4	50.4	58.4	68.0

In 1885 and 1886 the date of development of several plants were as follows:

		1885.	1886.
Cherry.	Rockport Bigarreau, first bloom	May 17.	Apr. 26.
Apple.	Early Harvest "	May 23.	May 6.
Raspberry.	Seneca "	June 8.	May 29.
Grape.	Monroe "	June 19.	June 14.
Strawberry.	Wilson. First ripe berry.	June 20.	June 9.
Pea.	Philadelphia. First edible.	June 20.	June 11.

In 1885 the Philadelphia Extra Early Pea vegetated May 9, bloomed June 4, and was at edible maturity June 22. In 1886 the same variety vegetated April 24, bloomed May 26 and was edible June 11. The sums of the mean daily temperatures for the two years were:

	From vegetation to bloom.	To edible maturity.	From bloom to edible maturity.
1885	1678 °	2892 °	1214 °
1886	1732	2917	1183

Or practically the same, notwithstanding the difference of planting, and that the period from vegetation to maturity varies 4 days in the two plantings.

In 1885, Pride of the North dent corn vegetated June 1, silked Aug. 3, or in 64 days; in 1886, the same variety vegetated May 31 and silked July 30, or in 61 days. The sums of the temperatures during these periods were as below:

	From vegetation to silking.
1885	4488 °
1886	4247

Or a mean air temperature of about 70 ° during the period from vegetation to bloom in both cases, but the higher temperature of June in 1886 seemed favorable to a quicker development of the plant than the lower mean temperature of June in 1885, although the July temperature was highest in 1885.

The summary of our weather records for the year is as below, the assumed average for comparison being the twelve years' continuous records of Professor Wilson, as published in our second report.

RAINFALL.

	No. of days on which rain was recorded.	Rainfall inches.	Average rainfall for 12 years.
Jan.	7	1.13	1.594
Feb.	6	0.95	1.138
Mar.	9	1.13	1.888
Apr.	10	4.13	3.375
May	7	1.92	2.933
June	7	2.92	2.121
July	12	4.41	3.281
Aug	6	2.86	3.690
Sept	11	2.31	2.499
Oct.	7	1.39	3.122
Nov	9	3.48	2.254
Dec	3	1.24	2.027
			29.922

TEMPERATURES.

	Greatest heat	Greatest cold	Mean of max. tem.	Mean of min. tem.	Mean monthly temp.	12 years' average mean mon. tem.
	°F.	°F.	°F.	°F.	°F.	°F.
Jan	52.5	—18.7	26.9	11.8	20.5	25.29
Feb.	49.0	—11.0	30.1	14.0	23.2	25.39
Mar.	62.5	— 2.5	37.0	23.4	32.4	32.26
Apr.	80.5	22.0	60.1	37.8	50.4	43.21
May	79.5	37.2	65.7	45.7	58.4	55.66
June	86.2	42.2	75.1	53.2	67.9	64.93
July	95.0	45.2	78.7	57.2	71.5	70.28
Aug	91.5	47.7	77.4	57.4	69.7	68.08
Sept	89.5	40.0	72.6	51.3	63.6	60.47
Oct	76.7	27.5	59.3	39.8	51.1	49.66
Nov	68.2	17.0	44.6	29.0	37.1	39.12
Dec.	46.	— 6.	29.1	15.1	22.9	25 56

The hottest average for the day, in twelve year records, was July 20, 1854, the mean temperature being 84.7°. In 1886 the hottest average day was July 6, 82.1°.

The coldest average day for twelve years was —14.2° on Feb. 6, 1885. In 1886, the coldest average day was January 12, being —5.2°.

The hottest and coldest points reached during the twelve years was 96.5° and—18.5°; the hottest and coldest recorded by us during 1886 was 95° and —18.7°.

SUNSHINE.

The sunshine records, as recorded by the Negretti and Zambra instrument, has been as follows:

	Hours time.		Per cent. of possible sunshine.	
	1885.	1886.	1885.	1886.
Jan	——	43–15	——	14.8
Feb.	——	80– 0	——	26.7
Mar.	——	83–15	——	22.3
Apr.	——	144–45	——	36.3
May	165– 0	235–45	36.4	51.9
June	237–30	252–15	52.0	55.2
July	284–45	243–15	53.8	52.6
Aug	163–30	240–15	38.1	56.0
Sept	206–45	200–30	55.3	53.7
Oct	134–30	142–45	39.3	41.8
Nov	53– 0	102– 0	18.1	34.8
Dec.	50– 0	68–30	17.6	24.2

REFLECTIONS UPON AGRICULTURAL EXPERIMENTS.

The leading work of an experiment station must, in order to be effective, be that which shall tend to discover the application of general and special laws and principles to agricultural subjects, and which shall enable control to be assumed for the purposes of gain. The complexities of the conditions which the farmer is called upon to meet, and with which he deals, are exceedingly numerous, and are so frequently involved in apparent contradictions as to offer problems of high character in their unravelment. We find change of soil and change of climate in whatsoever direction we go from the Station grounds, and hence conclusions which are founded simply upon success upon one farm, without consideration of relations of cause and effect, can be expected to find no certain or decisive application elsewhere. Experimental research requires that our whole attention be given to the relation of causes and conditions, and the defining of these in such a manner as to give a certainty of conclusion for all cases where like conditions are to be met with or can be obtained. Our average crops are supposed to receive about five per cent. of their substance from the soil, and about ninety-five per cent. from the atmosphere; it hence follows that meteorological relations must influence in all attempts to gain a maxima crop, and it must follow that fertility alone cannot be expected to be a decisive feature, although a paramount feature in proper relations with climatic and cultural conditions. Thus in my Massachusetts home, one hundred bushels of shelled corn per acre was not an unfrequent yield in good seasons and upon accidental acres; at the Station, without reference to the applied fertility and the highest cultural conditions, this amount of yield has not been approached. The suggestion that the amount and intensity of sunlight in the eastern locality is greater than in this lake region, is an hypothesis with at present seems to fully explain, but which, however, requires actual demonstration before its acceptance.

METEOROLOGY.

The value of meteorological observations can scarcely be overestimated, but to have a true value in experimental work they must be very complete. Our error from the beginning has been that we have not devoted enough attention to this branch of agricultural science. Not that blame can be ascribed for this omission, but simply because circumstances have not rendered it desirable to force into a prominent position a branch of our work whose importance, although appreciated by us, has not as yet the full appreciation of the public.

To take the air temperatures alone, to keep a record of the rainfall, is scarcely sufficient for agricultural experiment. Our study should include the soil temperatures, not only in one place, as we have already done, but should entertain the question as to the influence of the character of the soil upon the soil temperatures. It should include a study into the forces expressed in evaporation and most particularly those expressed by the term capillarity. Capillary water, or that amount of saturation which capillarity is capable of effecting, seems one of the most beneficial influences toward promoting plant growth that we are acquainted with, while what we may call water in the soil, *i. e.*, a saturated condition such as exists below the water table, is exceedingly detrimental to vegetable life. In the greenhouse, in order to have healthy growth, we are perfectly well aware of this distinction between what we will call soil water and capillary water. The earth, which becomes soggy, and which holds water in excess over that which is retained by capillarity, makes a healthy growth nearly impossible for the majority of our plants; while on the other hand, keeping the land fully supplied with capillary moisture is found extremely beneficial, and one of the main efforts of the gardener is to get his soil into a condition of perfect drainage. One of the most beneficial actions of tile draining is to prevent the access of this soil water, or stagnant water, to the soil above, allowing only the water of capillarity to remain in the cultivated portion. A single rain, in our locality, rarely penetrates the soil to the depth of the drain tile, the water which appears in the drain being either a displacement of the capillary water by the water of the rainfall, or else the raising of the water level which supplies the drain below. To measure this capillarity in its relations to the character of the soil and in its relation to our power to profitably change the character of the soil, is one of the most important problems in agriculture, and one which seems to have received comparatively little attention.

We have already done some work, scarcely complete enough for record, but yet sufficient to indicate the importance of this character of investigation, at various times during the last few years. The work of our Horticulturist has been especially fruitful of clues, as will be seen by his report. The majority of our agricultural plants do not form root-hairs in any appreciable quantity in clear water, while these hairs are oftentimes produced abundantly in a perfectly saturated atmosphere. The same fact has been observed as between saturated soil, and soil kept moist through capillary attraction. As these root-hairs furnish very largely the food resources of the plant, the importance of this observation can scarcely be overestimated.

The color of the soil influences the reception of heat during the sunlight and the radiation of it into space during the night. During most of the growing season the balance seems to be in favor of the absorption of heat, but we should know accurately how much earliness is dependent upon the color of our soil, and also the corresponding influence of color upon the amount of evaporation which takes place from the soil.

The question of the influence of sunlight upon plant growth and development is a very important one. Without these records we can scarcely suggest an explanation of why periods of maturity should vary in different years, or as between different plantings during the same season. We have already shown that the units of temperature alone during the period between vegetation and maturity are not sufficient to furnish a solution of this problem, and we have received clues which suggest that one of the wanting factors is the recording of the sunlight. From these reflections it will be at once seen that one of the greatest needs of agriculture is a careful and extended study of the soil and those soil conditions which come under the head, directly or indirectly, of meteorology. With this question is also involved the chemical considerations concerning what may be called chemical reactions within the soil, as nitrogen in its agricultural form finds ready escape from the land through the drainage, and it would at first thought be supposed that the amount of nitrogen would be greater in the lower than in the upper layers of the soil. Observations, however, show that the upper soil is richer in this element than the lower portion of the soil. This undoubtedly comes in part from the action of capillarity, whereby the nitrates carried down by the rain are brought to the surface again through evaporation, which is continually taking place and drawing water and its soluble ingredients from below upwards. In the summer-rainless regions of the west this capillary action finds expression which is recognized in the truly alkali lands, the soluble alkalies being brought to the surface in excess and deposited there in a crystalline form, thus destroying the value of the land for agricultural purposes.

Each portion of a plant seems to have a temperature at which its functions are best performed. We have stated in a previous report that maize seed will germinate at or about 41 degrees F., but the growth at this temperature is very slow. If the growing plant has its roots exposed to a temperature of about 60 degrees F., wilting will occasionally take place. This seems to come from the fact that the function of the roots to absorb water cannot be performed at this temperature sufficient to furnish the water lost through evaporation from the leaves. A similar action may often be observed during the warmest and driest portion of the summer, when the roots fail to supply the amount of moisture thrown off by the leaves, and hence wilting or curling ensues. When the wilting comes from this cause and the evaporation is checked at night, the leaves unroll and the plant shows its normal vigor. The effect of this concentration or drawing off of the plant juices seems beneficial in forwarding crop. I have observed during many years, that in seasons when the corn curled at daytime, but uncurled at night, such were seasons of large yields; but when the curling came from the true lack of water, as evidenced by the plant not unrolling at night, then a serious injury to crop was the result. We thus seem to be able to discriminate between two kinds of wilting: one coming from the absence of sufficient water in the ground, a disadvantage to the plant; the other coming from the physiological action of plant growth whereby transpiration becomes in excess of the ability of the roots to supply, and which seems favorable to crop yield.

Early planting is usually recommended, but the rationale seems little understood. It is a matter of observation that there are conditions often apparent between crops of early and late planted seed. It is also a simple matter of demonstration that during the spring season the soil is in general warmer than the air, while in a later season these conditions are not as pronounced. During a warm spell in the spring the soil becomes well warmed, a cool spell follows, and then we have as contrasted conditions, a warm soil and a cool air. We may now ask ourselves as to the influence these conditions have upon the plant. We know that in the greenhouse the gardener who desires thrifty plants often encourages the root growth through bottom heat and a cool air, and after the plant has thus become well established increases the air temperature and thus gets rapid and healthy growth. In spring nature furthers this process for us. The corn plant may serve as an illustration. During a cool spell after it is seen above the ground, the farmer may note very little progress in its growth, because the farmer only looks at externals; but were he to examine the rooting habit of the plant he would find that this apparently stationary plant is extending its roots rapidly in a warmer soil, so that when a warm season follows this apparent resting spell, the plant is already furnished with an abundance of roots, and responds in a rapid growth. It seems, from such data as we possess, that we are safe in saying that the variable weather of the spring season, whereby there are alternations of periods wherein the soil is warmer than the air, and the air warmer than the soil, is very favorable toward that healthy and well-balanced growth of the plant which, in the presence of fertility, may be expected to result in abundant crop. A very superficial examination of our temperature records will indicate the existence of the conditions that we have outlined as respects the soil and air temperatures. A very limited experience with greenhouse plants suffices to give indication of the importance of bottom heat and a cool air temperature as contributing to root growth, and the influence of a high air temperature with a comparatively cool soil temperature toward promoting growth in the foliage. The observant farmer may also note the application of these principles in certain of his crops, perhaps best to be observed in the corn plant. It has been a nearly constant observation of mine, and I have met others who have also noted a like circumstance, that upon soil which we know to be fertile, the corn plant yields better when early planted during the spring seasons when there is considerable alternation in temperature, than later when the temperatures as between soil and air have become more constant. Or, as may be expressed from the resultant effect, it is not well to see plants exceedingly vigorous during the early season, but better to see plants showing less vigor, yet healthy vigor in the foliage. Large early growth seems rarely to give equal results in crop with a slow yet healthy spring growth. In cereals, the condition known as "proudness" seems often to result from the over-development of the leaf as contrasted with the root development, especially when growing in very fertile soil under the stimulus of a warm season.

The mechanical effect of the wind upon a young plant is at times quite noticeable. A transplanted plant often finds great difficulty in becoming established, especially if set in loose soil, as the wind moving the stem to and fro presses the earth from contact and produces a movement in the roots which prevent their establishment. Under these circumstances, compression of the ground about the newly transplanted plant by trampling has been found beneficial, and many times this process will offset the injurious action of the wind. A shingle stuck into the ground as a shelter will often prove of great advantage. It seems always more difficult for a plant to become established in a loose soil than in one which is well firmed, and this difficulty, in the presence of continuous wind storms, often becomes serious as before mentioned, but the partial remedy of firming the ground seems known to and practiced by but few.

The apparently desultory nature of experimental work in the first years of an experimental station finds illustration in our reports, and seems to arise from a necessity which is fully recognized by your director. While in theory the varied work of different observers should be harmonized towards one conclusion, and towards the elucidation of one central idea, in practice this course has seemed impracticable, through the imperfection of our data, and the confused condition of so-called agricultural knowledge. It is hoped that with the progress of station work, this difficulty may be overcome. The relations of the physiology of plant growth with meteorological conditions form a study which would be considered as fundamental, if we would interpret aright the experiences of practical and comparative trial, and the same remark applies to the soil relations as well. Yet our working force has been insufficient to carry out such a study in its necessary completeness, while a public sentiment yet but illy educated to the requirements of experimental investigation, forbids the neglect of less advantageous, but more popular directions of labor. Our lysimeter tables are given as usual in this report, and their full discussion is as yet postponed until further progress is made; so also are our temperature tables and sunlight records. At some future time these figures, so uninteresting in themselves, may prove to have a high value, when studied in their relations to the tabular data, so prominent in our various reports, and may be expected to throw light upon obscure conditions, and may satisfactorily explain the apparent contradictions which ever and anon occur in so-called practical work. I refer to these matters in this place, to indicate that our opportunities are not as yet sufficient for our desires.

Agricultural experiment work must ever deal with theories, and must avoid accepting the results brought about through complex conditions, as true facts available for generalization. It is only as our apparent facts are studied in their relation to the causes which have produced them, that they become of value. To report that a cow under a given food has yielded 20 pounds of butter a week, or 40 quarts of milk, or to give the chemical composition of the milk, may represent a series of ascertained facts, and yet, so far as experiment is concerned, such facts have little value until connected with the causes which have produced them; and seeking out these causes involves theories which must stand the test of verification. In trials of this character, the test of duplication seems the available one in order to secure certainty, for if a second trial with the same animal produces a different set of results, or if another animal is used, we find the same relations do not hold in the various trials, either our theory is at fault, or there is a deficiency in our interpretation.

If in our plats we find that under conditions as uniform as we can obtain there is less difference between the crops harvested from plats dissimilarly treated than exists between other adjoining plats treated alike, this comparison indicates very fairly the inaccuracy of the method used. Agricultural results to be of value must come under the general laws of scientific study, whereby results in other branches of science have been gained, and which may be expressed by the term ability to duplicate. The true work of a station must be first scientific, and second, the application of the results thus gained toward solving the practical problems whose solution shall tend to the advancement of the farmer. There is scarcely any branch of science which deals with such complexity of factors as that which meets the farmer and the agricultural experimenter in every day work, and before that accuracy can be obtained which science requires and which adds confidence to the conclusions attained, we must note the extent of the action which each factor has contributed toward the result gained. That this is possible, I thoroughly believe; but I can see that before such success is accomplished very much work is required, and our course must ever receive directions from multitudes of failures, for in experimental work failures oftentimes may be made equal value with successes.

In this connection I quote from the address of Professor G. N. Darwin, before the British Association for the Advancement of Science:

"A mere catalogue of facts, however well arranged, has never led to any important scientific generalization. For in any subject the facts are so numerous and many-sided that they only lead us to a conclusion when they are marshalled by the light of some leading idea. A theory is, then, a necessity for the advancement of science, and we may regard it as the branch of a living tree, of which facts are the nourishment. In the struggle between competing branches to reach the light some perish, and others form vigorous limbs. And as in a tree the shape of the young shoot can give us but little idea of the ultimate form of the branch, so theories become largely transformed in the course of their existence, and afford in their turn the parent stem for others.

"The success of a theory may be measured by the extent to which it is capable of assimilating facts, and by the smallness of the change which it must undergo in the process. Every theory which is based on a true perception of facts is to some extent fertile in affording a nucleus for the aggregation of new observations. And a theory, apparently abandoned, has often ultimately appeared to contain an element of truth, which receives acknowledgment by the light of later views."

The plat experiments of this year, as in the past, serve but to accentuate our previous conclusions as to their worthlessness for their intended purpose. Before such trials can be of importance there is a necessity for much preliminary work designed to further attempts at separating and studying the various factors which in their complex entirety find expression in yield of crop. The report of the trials made will, I think, substantiate this expression of doubt, and may well be studied in their details, as such study will show that the results of experiments designed as duplicates do not give the same answer in different years, nor even do the closer duplicates of the current year, and that a logical interpretation of the figures as given bring us to conclusions that are absurd. It is only as the figures obtained are arranged according to a preconceived notion, and figures contradictory to our intentions are rejected, that definite conclusions can be reached, and of course when reached by this unfair and untruthful method, such conclusions can have no value. I must use this opportunity to again express my firm conviction that it is only through scientific investigation that practical results can be secured, and that plat work is absolutely fallacious, and should be abandoned for the present, the plat areas being used only for the purpose of verifying results reached through the slower and more laborious method of working which carries us safely from the known towards the unknown.

Our feeding experiments of the year bring forward several points of interest, and illustrate the difficulty of interpreting results which are the outcome of complex conditions. The feeding of two animals upon unchanged kinds of food during the period of experiment, throws some light upon some variations which may and do occur under unchanged conditions of food and keeping. Such trials as these demonstrate the necessity of further study, designed to give information as to how to interpret results gained through change of food or changed conditions, for at present we are at a loss to so interpret our feeding experiments as to demonstrate the relations of cause and effect, but have to be content with probabilty, more or less high.

The work of the first assistant upon cereals has been close and unintermittent, and the establishing of synonyms has been so carefully and cautiously effected as to be worthy of the highest confidence. The nomenclature of our cereals is in such an uncertain and involved state, that this work of the station must be considered of prime importance. Agricultural research upon plants and plant life, cannot be carried forward efficiently until we are able to identify varieties so as to be assured that the results of work carried forward at different stations applies to the same variety, or to the variety which is named. Such work is also important for the farmer, for the same grain is often sold under several different names, and a different price for each name.

In accordance with our custom of making a specialty of some one of our garden vegetables each year, we selected the cabbage, and in the Report of the Horticulturist will be found the nomenclature and the description of such varieties as we have grown. The tabular data regarding the various vegetables grown by us, is also given as usual, as well as the result of various experimental trials. The work of the Horticulturist has been incessant and wearying, yet its value cannot but be recognized, as furnishing reliable data, if correctly interpeted, towards future research, as well as in present results.

The Report of the Chemist is noteworthy as dealing with a new method of studying milk and butter, through the recognition of viscosity as a factor which seems to have a close and direct relation to the practical questions which so constantly arise. This study has also furnished clues of great interest, and which seems to promise a means for recognizing and recording those variations in milk which arise from the "condition" and the individuality of the cow, as well as those conditions of the milk which are corelated with ease and success in the manufacturing of butter. To Mr. Babcock is due the credit of initiating and successfully carrying forward these most interesting and valuable investigations.

The work of the Assistant Chemist upon artificial digestion furnish results of promise. The close approximation of the percentages gained by the pepsin method, with those gained from actual trial with animals, seem to afford good ground for the belief in the practicability and reliability of this method for establishing the true feeding value of a food. As will be seen from Mr. Ladd's report, the trials include a large variety of cattle foods, and furnish chemical analyses as well.

Our analytical work differs from that accomplished in many laboratories, as the material subject to analysis has been in most cases sampled by ourselves, and selected either for uniformity as between various samplings, or as representing that grown or collected under average conditions. But few of our samples have been furnished by outsiders, and thus we think the personal equation in sampling has been brought to as near a constant as is possible under the conditions which affect the collecting.

Since my last report a dairy building has been erected, the basement of brick, with hollow walls, the superstructure of wood, paper lined, and sheathed internally. Within the basement is the dairy room, 17 ft. 6 in. by 11 ft. 1 in; a milk room 9 ft. 10 in. by 7 ft. 6 in.; a cellar room 10 ft. by 9 ft. 10 in.; a churning room 8 ft. 2 in. by 6 ft. 7 in.; and a furnace room 8 ft. 8 in. by 5 ft. 10 in. The upper room is

29 ft. by 19 ft., and above is a storage loft of the same size. The equipments are a Shipman one-horse power steam engine, a Cooley creamer, No. 3, a Fairbanks scale weighing from 1-8 ounce to 250 lbs., an experimental churn, and a furnace, together with ordinary dairy utensils. This structure is built so as to make it easy to maintain a comparatively uniform temperature, and thus far it has met well all our expectations. The engine seems to meet with all the requirements of a small power, combining ease of management, with safety and economy, kerosene being used for fuel, and as this fuel is only used while actually at work, but little is required. The Cooley creamer is too well known to require further mention, and with us it upholds its well-earned reputation.

An extension of thirty-five feet has also been added to the greenhouse, nearly doubling its former capacity.

DONORS.

We desire to express our renewed obligations to Messrs. Vilmorin, Andrieux et Cie, Paris, France, and J. M. Thorburn & Co., 15 John St., New York, two of the largest seed firms with which we are acquainted, for a large variety of seed for which they will receive no pay, but ever express the desire to furnish whatsoever in their line that we may require. A number of other firms have also given us the carte blanche of their vegetable catalogues. Such a generosity is very agreeable to us, as indicating a belief that our work with vegetables is worthy of encouragement. Had circumstances led us to call largely upon these firms, they would have deserved and received a fuller mention than the mere record.

Nov. 23, 1885. Of A. C. Hammond, Sec'y, fourteen volumes of the Transactions of the Illinois Horticultural Society, 1868 to 1871, 1875 to 1884.

Nov. 28. Of Hugo Beyer, New London, Ia., three packages of vegetable seed.

Nov. 29. Of M. P. Prince, Henderson, N. C., eight varieties of cow pea.

Oct. 8. Of Hon. E. G. Lapham, U. S. S., report of the Chief of Signal Service, 1878–9.

Dec. 9. Of Lucian Rust, Loudonville, O., pod corn seed.

Dec. 23. Of Charles Carpenter, Kelley's Island, O., lettuce seed.

Jan. 5, 1886. Of Royal Gardens, Kew, England, two packages of *solanum maglia* tubers.

Jan. 16. Of Thos. N. Woodason, 74 Canalport Avenue, Chicago, Ill., one improved atomizing bellows.

Jan. 26. Of Department of Agriculture, Washington, D. C., and at numerous other times during the year, various kinds of seed, reports, etc.

Jan. 26. Of the Rose Manufacturing Company, New York, two packages of Tobacco Insecticide soap.

Jan. 27. Of J. M. Thorburn & Co., seedsmen, New York, ninety-one packages of seed; Apr. 30, ten pounds Alfalfa seed.

Jan. 27. Of Peter Henderson & Co., seedsmen, New York, eighty-four packages of seed.

Feb. 4. Of B. Hammond, Fishkill, N. Y., two packages of slug shot.

Feb. 10. Of Hon. J. W. Wadsworth, M. C., Vol. XIII U. S. Census, 1880; July 1, Vol. XVI U. S. Census, 1880.

Feb. 10. Of J. A. Everitt, seedsman, Watsontown, Pa., the privilege of selecting seed from his catalogue free of cost.

Feb. 22. Of A. G. Tillinghast, Padilla, W. T., one package seed corn; also five packets of Puget Sound grown cabbage seed.

Feb. 24. Of T. V. Munson, Denison, Tex., a package of lettuce seed; and on March 19, eight seedling grape vines.

Feb. 27. Of Field Force Pump Co., Lockport, N. Y., one Field Force Pump (for spraying trees, etc.), with hose and nozzle.

Feb. 27. Of F. H. Horsford, Charlotte, Vt., five packets of seed.

Mar. 5. Of A. B. Cleveland, Cape Vincent, N. Y., three packets of seed.

Mar. 6. Of J. W. Goodell, Canastota, N. Y., scions of the "Ella" apple.

Mar. 9. Of A. W. Livingston's Sons, Columbus, O., Paragon tomato seed; May 31, two packets of squash seed; June 7, two plants of a new tomato.

Mar. 19. Of O. H. Alexander, Charlotte, Vt., various kinds of seed.

Mar. 22. Of Pringle & Horsford, Charlotte, Vt., twenty-three varieties of potatoes and cereals.

Mar. 22. Of Prof. F. A. Gulley, Miss. Agricultural College, seed oats.

Mar. 22. Of Ohio Experiment Station, Columbus, O., nineteen varieties of oats.

Mar. 22. Of T. L. Harison, Albany, N. Y., ten volumes of German books.

Apr. 10. Of S. A. Taylor, Fitzwilliam Depot, N. H., four kinds of seeds.

Apr. 11. Of Eureka Salt Manufacturing Co., New York., one 14 lb. bag of Higgins Eureka Dairy Salt.

Apr. 14. Of John B. Moore & Son, Concord, Mass., one Eaton grape vine.

Apr. 20. Of E. W. Powell, Clinton, N. Y., four kinds of seed.

Apr. 20. Of James Vick, seedsman, Rochester, N. Y., three packages of peas.

Apr. 21. Of Chas. Carpenter, Kelley's Island, O., six plants each of Naomi, Erie and an unnamed hardy seedling raspberry, also sixteen plants Covill's Early Strawberry.

Apr. 23. Of E. J. Brownell, Franklin, N. Y., six plants Mederith Queen raspberry.

Apr. 23. Of Mrs. E. T. Duck, Levanna, N. Y., various seeds and plants.

Apr. 27. Of Daniel Batchelor, seedsman, Utica, N. Y., lettuce seed; May 16, beans and rye.

Apr. 28. Of E. M. Buchley, Greenville, O., six plants of a new seedling strawberry.

Apr. 28. Of J. Reilley, seedling potatoes.

May. 8. Of T. H. Betts, Cropseyville, N. Y., wild potato tubers from Arizona.

May. 10. Of Smithsonian Institute, Washington, D. C., report of 1884.

May 11. Of I. F. Tillinghast, La Plume, Pa., two varieties of potato, and six packages of Puget Sound cabbage seed.

May 16. Of Frank Finch, Clyde, N. Y., Finch's Early Perfection potato.

June 7. Of Wm. Henry Maule, seedsman, Philadelphia, Pa., thirty-five packets of vegetable seed.

June 22. Of Prof. Hilgard, University of California, one package of wild oats.

June 27. Of International Terra Cotta Lumber Co., Chicago, Ill., one barrel of terra cotta for experimental work.

July 21. Of Geo. J. Brainard, Brockport, N. Y., a quantity of peach buds.

Aug. 18. Of J. D. Kmschke, Piqua, O., one dozen Miami strawberry plants.

Sept. 27. Of W. W. Rawson & Co., seedsmen, Boston, Mass., the privilege of selecting from their stock free of charge.

Oct. 23. Of H. S. Reynolds, secretary, reports of the Michigan Board of Agriculture for 1885.

Oct. 21. Of Messrs. Vilmorin, Andrieux et Cie, 17 var. of barley and 9 of oats.

Oct. 23. Of Prof. A. E. Blount, Fort Collins, Col., samples of wheat.

Nov. 1. Of Hon. J. H. Wadsworth, Vol. XX United States Census

Nov. 1. Of the Secretary of the Smithsonian Institute, the Smithsonian Report for 1884, part 2.

Nov. 3. Of Prof. L. H. Bailey, Agricultural College, Michigan, some tomato seed from Peru.

Nov. 5. Of Messrs. Miller & Sibley, Franklin, Pa., a sample of Jersey butter made from centrifugal separated cream.

Nov. 8. Of Prof. O. A. Derby, Rio Janeiro, Brazil, sample of corn grown by Indians of San Paulo province, Brazil.

Nov. 8. Of Valancey E. Fuller, Hamilton, Ont., a sample of Jersey butter made from centrifugal separated cream.

Nov. 9. Of Messrs. Smiths, Powell & Lamb, Syracuse, N. Y., a sample of Holstein butter made from centrifugal separated cream.

The following papers have been supplied us regularly through the generosity of the publishers :

American Analyst, New York, N. Y.
American Chemical Fertilizer and Crop Journal, New York, N. Y.
American Grange Bulletin, Cincinnati, O.
Boston Weekly Post, Boston, Mass.
Canadian Entomologist, London P. O., Canada.
Chautauqua Farmer, Dunkirk, N. Y.
Farmers' Advocate, London P. O., Canada.
Farmer and Dairyman, Syracuse, N. Y.
Farmers' Review, Chicago, Ill.
Fruit Recorder, Palmyra, N. Y.
Geneva Advertiser, Geneva, N. Y.
Geneva Courier, Geneva, N. Y.
Horticultural Art Journal, Rochester, N. Y.
Independent Statesman, Concord, N. H.
Maryland Farmer, Baltimore, Md.
Massachusetts Ploughman, Boston, Mass.
Mirror and Farmer, Manchester, N. H.
National Live Stock Journal (monthly and weekly editions), Chicago, Ill.
New England Farmer, Boston, Mass.
New York Tribune (weekly edition), New York, N. Y.
New York Weekly News, New York, N. Y.
Oil, Paint and Drug Reporter, New York, N. Y.
Orchard and Garden, Little Silver, N. J.
Our Country Home, Greenfield, Mass.
Popular Gardening, Buffalo, N. Y.
Philadelphia Weekly Press, Philadelphia, Pa.
Practical Farmer, Philadelphia, Pa.
Produce Exchange Bulletin, New York, N. Y.
Rural New Yorker, New York, N. Y.
Students' Farm Journal, Ames, Ia.
Sugar Bowl and Farm Journal, New Orleans, La.
The American Cultivator, Boston, Mass.
The American Farmer, Baltimore, Md.
The American Florist, Chicago and New York.
The American Garden, Springfield, Mass.
The Cultivator and Country Gentleman, Albany, N. Y.
The Delaware Farm and Home, Dover, Del.
The Dunkirk Journal, Dunkirk, N. Y.

The Farm and Garden, Philadelphia, Pa.
The Farmer, Malone, N. Y.
The Home Farm, Augusta, Me.
The Husbandman, Elmira, N. Y.
The Industrialist, Manhattan, Kan.
The Jersey Bulletin, Indianapolis, Ind.
The New England Homestead, Springfield, Mass.
The Ohio Practical Farmer, Cleveland, O.
The Orange County Farmer, Port Jervis, N. Y.
The Phelps Citizen, Phelps, N. Y.
The World (weekly edition), New York, N. Y.
The Southern Cultivator, Atlanta, Ga.

HOW MUCH EXCREMENT IS PASSED DAILY BY COWS.

The figures gained from our experiments of 1883 and 1884 show that this amount is very variable. We indicate the conditions, and the amount in the table following.

1883.—AVERAGE OF FOUR COWS.

	Weight of cows: lbs.	Ration.	Av. wt. of ration: lbs.	Av. amt. of excrement: lbs.
Jan. 5– 7	..709	Hay, meal, shorts	24.9	57.1
Jan. 12–14	..720	Hay, shorts	23.9	58.5
Jan. 17–19	..712	Hay, gluten meal	21 0	43.4
Jan. 23–25	..705	Hay, meal	20.8	43.4
Feb. 1– 3	..678	Hay, meal, ensilage	33.9	29.6
Feb. 9–11	..705	Hay, ensilage	57.7	40.5
Feb. 15–17	. 685	Hay, meal, shorts	20.8	47.1

1884.—AVERAGE OF TWO COWS.

					The excrement was	
					Dung: lbs.	Urine: lbs.
Jan. 21–24	..728	Corn fodder, meal, shorts	34.6	51.1	39.7	11.4
Feb. 4– 7	..747	Ensilage, meal, shorts	78.0	47.1	33.8	13.3
Feb. 16	..725	Soja bean, meal, shorts	25.3	40.8	29.8	11.0
Feb. 26–29	..718	Hay, meal, shorts	26.3	54.2	45.5	8.7
Mar. 10–13	..715	Hay, meal, shorts, potatoes	61.4	63 3	42.5	20.8

We observe that for cows of from 678 to 747 lbs. weight, under various kinds of food, the total excrement passed, varied from about 30 lbs. to 63 lbs. daily. Under the like feed, hay, meal and shorts in about the customary proportion in good feeding, the excrement weighed 57, 47 and 54 lbs.; under hay, grain and ensilage feeding the excrement voided figured up 30 lbs. and 47 lbs. We observe, however, that there is an increase of excrement whenever shorts are fed. Thus selecting the periods when dry feed was used, in the six periods when shorts were used the excrement varied from 41 to 58 lbs. daily; when no shorts were used 43.4 lbs. in each of the two periods; in the one period when shorts alone were fed, the maximum amount of excrement was noted.

The average amount of excrement voided by the animals during the above periods was 48 lbs. daily; the daily average for 110 days was 48.5 lbs.

During the winter season, a stabled cow may be assumed to supply about 48 lbs. x 30 days=1440 lbs. of manure per month.

The dry matter in the food and the excrement in the above periods, was:

1883.—AVERAGE OF FOUR COWS.		1884.—AVERAGE OF TWO COWS.	
Dry food consumed.	Excrement.	Dry food consumed.	Excrement.
21.2	57.1	18.7	51.1
20.5	58.5	17.2	47.1
18.8	43.4	20.1	40.8
17.3	43.4	19.0	54.2
9.6	29.6	17.3	63.3
12.3	40.5		
17.7	47.1		

The average relation is, therefore, in 1883, the excrement 2.7 times the weight of the dry food: in 1884, 2. 7 times the weight of the dry food We may therefore assume that in practical feeding we cannot be far wrong when we estimate that the excrement amounts to about two and a half times the weight of hay and grain fed.

HOW MUCH WATER DOES A COW DRINK.

This question has an interest in relation to water supply. There is, however, a great individuality as between different animals in regard to the water they drink, and the amount is somewhat influenced by temperature. Thus December 11 to 26 inclusive, 1885, four cows drank daily, for an average, as below, the food being the same:

	Average live weight. lbs.	Daily water drank. lbs.	Maxima and minima days. lbs.	lbs.
Ann	998	123.6	144.7	101.
Emm	860	82.5	104.0	61.6
Jem	853	85.9	107.0	59.2
Meg	908	75.8	84.9	70.9

The amount of water drank is diminished with succulent food, as for illustration. Two cows, Jem and Meg, drank for a daily average:

Period.	Ration.	Water drank: lbs. Jem.	Meg.
Nov. 9–24	Hay and 4 lbs. meal.	70.6	62.6
Nov. 25–Dec. 10	Hay and 40 lbs. turnips.	53.0	46.2

The same cows do not drink the same quantity during different periods under like feeding. Thus Ann and Emm fed on 4 lbs. meal and hay ad libitum, drank the following amounts for a daily average:

Period.	Ration.	Water drank: lbs. Ann	 Emm.
Nov. 9–24	Hay and 4 lbs. meal.	70	63
Nov. 25–Dec. 10	do	104	76
Dec. 11–26	do	123	82
Dec. 27–Jan. 11	do	110	65
Jan. 12–27	do	98	44
Jan. 28–Feb. 12	do	107	50
Feb. 13–28	do	110	60
Mar. 1–16	do	111	57
Mar. 17–April 1	do	127	79
April 2–17	do	126	78

The weight of water drank per cow, at different times, are as follows :

1883. AVERAGE OF FOUR COWS.

Period.	Ration.	Average wt. of water drank daily: lbs.
Jan. 1–7	Hay, meal, shorts.	63.6
" 8–14	Hay, shorts.	65.0
" 15–19	Hay, gluten meal.	53.9
" 20–25	Hay, meal.	52 2
" 26–Feb. 3	Hay, meal, ensilage.	25.5
Feb. 4–11	Ensilage.	2.6
" 12–17	Hay, meal, shorts.	50.5

1884. AVERAGE OF TWO COWS.

Period.	Ration.	Average wt. of water drank daily: lbs.
Sept. 17–25	Hay.	85.2
Nov. 4–12	Hay.	60.1
Jan. 11–24	Corn fodder, meal, shorts.	48.3
" 25–Feb. 10	Ensilage, meal, shorts.	3.8
Feb. 11–16	Soja bean, meal, shorts.	50.2
27–29	Hay, meal, shorts.	62.6
Mar. 1–13	Hay, meal, shorts, potatoes.	32.6

1885. AVERAGE OF TWO COWS.

Period.	Ration.	Average wt. of water drank daily: lbs.
Nov. 9–24	Hay and meal.	66.6
" 25–Dec. 10	Hay and turnips.	49.6
Dec. 11–26	Hay and cotton seed meal.	80.4
" 27 Jan. 11	Hay.	73.5
Jan. 12–27	Ensilage.	10
" 28–Feb. 12	Ensilage and meal.	13
Feb. 13–28	Hay and meal.	80
Mar. 1–Feb. 16	Hay and turnips.	71
Feb. 17–Apr. 1	Hay and cotton seed meal.	94
Apr. 2–17	Hay.	99

The general teaching of these trials is therefore that a water supply should be sufficient to furnish an average of about 8 gallons daily per head for the cows kept, in order to be assured of a full supply.

INFLUENCE OF DISTANCE FROM CALVING ON MILK YIELD.

In experimenting upon the feeding of milch cows it is often necessary to be able to calculate the extent to which the flow may decrease under the influence of distance from calving. For the purpose of investigating this question we have gone over the milk records of the Waushakum farm herd, South Framingham, Mass., as kept by the Sturtevant Bros., from December, 1866, to December, 1881, inclusive, and have arranged the milk yields of each cow for each thirty days from calving. These records are:

For 35 different native cows, and 59 calvings.
For 45 different Ayrshire cows, and 145 calvings.
For 3 different Jersey cows, and 6 calvings.

While the natives were kept, the feeding was liberal, yield being the objective point, regardless of the calves. While the Ayrshire cows were maintained, the feeding was lower, as befitted a breeding herd, and the records embrace the yield of many young animals in their first year of milk. For the whole herd, during the fifteen years, the calvings were quite well distributed over the year, no particular season for calving being desired, as the milk was disposed of at retail during much of the time.

We give a table of our results under two heads: the first embraces every cow, farrows as well as those in regular calvings, and cows which only remained a few months in the herd. The second embraces only those cows which went dry between the eighth and twelfth month from calving.

TABLE I.
For whole herd.

Month from calving.	No. of monthly records.	Av. yield per month. lbs.
1	210	771
2	206	731
3	197	659
4	195	597
5	191	518
6	183	465
7	175	448
8	153	403
9	119	370
10	93	334
11	60	317
12	38	326
13	26	349
14	19	358
15	15	366
16	13	319
17	10	316
18	9	308
19	6	306
20	4	302
21	4	243
22	3	271
23	2	284
24	2	238

TABLE II.
For cows that went dry bet. 8th and 12th month.

Month from calving.	No. of monthly records.	Av. yield per month. lbs.
1	121	808
2	121	757
3	121	685
4	121	617
5	121	560
6	121	511
7	121	451
8	121	380
9	88	348
10	63	312
11	34	254
12	13	223

If we examine the differences between the yields of successive periods, we do not perceive much uniformity. Yet if we calculate the average daily yield during each period, and estimate the falling off by percentages, we may note that the apparent decrease is about nine per cent. of the yield for a preceding period; or the same percentage may be calculated on the total yields. We will place in column the actual results tabulated, and alongside the yield of each period decreased by nine per cent., and this we will call the theoretical yield.

FOR THE WHOLE HERD.

	Actual daily milk yield: lbs.	Theoretical daily milk yield: lbs.	Actual yield per month: lbs.	Theoretical yld. per month: lbs.
1st mo.	25.7	25.7	771	771
2nd "	24.4	23.4	731	702
3rd "	22.0	21.3	659	639
4th "	19.9	19.4	597	582
5th "	17.3	17.7	518	530
6th "	16.5	16.1	495	483
7th "	14.9	14.7	448	440
8th "	13.4	13.4	403	401
9th "	12.3	12.2	370	365
10th "	11.1	11.1	334	333

FOR THE COWS THAT WENT DRY BETWEEN 8TH AND 12TH MONTH.

	Actual daily milk yield: lbs.	Theoretical daily milk yield: lbs.	Actual yield per month: lbs.	Theoretical yld per month: lbs.
1st mo.	26.9	26.9	808	808
2nd "	25.2	24.5	757	736
3rd "	22.8	22.3	685	670
4th "	20.6	21.3	617	610
5th "	18.7	18.5	560	555
6th "	17.0	16.9	511	504
7th "	15.0	15.4	451	459
8th "	12.7	14.0	380	418
9th "	11.6	12.8	348	381
10th "	10.4	11.6	312	346

We therefore believe that the natural falling off in milk for each month from calving, is about 9 per cent. of the yield of the preceding month.

CATTLE FEEDING EXPERIMENTS.

The scheme of the cattle feeding experiments for the winter of 1885 and 1886, was two-fold : the one purpose being to determine the changes in live weight and milk yield which may be expected to occur during periods of even length under like food and management. The second purpose being to study the influence of changed foods as expressed in live weight and milk yield. The cattle used were four Jersey cows, the same animals which appear in our experimental records of past years. On account of the pressure of other duties in the laboratory we were unable to continue a series of milk analyses during these trials. The analyses of the foods used are as below:

	Water.	Album.	Crude fiber.	Nit.-free extract	Fat.	Ash.
Hay	16.04	4.83	26.28	46.88	2.18	3.79
Corn meal	12.88	9.90	2.81	68.87	4.16	1.38
Turnips	92.40	1.25	1.20	4.20	.23	.72
Cotton seed meal	8.45	41.88	3.45	20.94	16.87	8.41
Ensilage	86.25	.93	4.79	6.42	.67	.94

The experiment commenced Nov. 9, 1885, and continued to April 17, 1886, inclusive, 160 days. The cattle were kept in the experimental barn during this whole period, receiving no exercise, and in general preserved good health. An examination of the daily records given below show a slight disturbance at period of calving, but it may be said that rarely do cows pass through a winter in better health than these animals kept under rigid conditions. The grain was fed in all cases in a weighed quantity; the other food was weighed and given freely, and the refuse food weighed back, so that the feeding was ad libitum.

The daily figures, the average figures for thirds of each period, and those for the whole of each period are given in full in the following tables, the starred figures indicating that the cow calved on the date named, or the period indicated:

TABLE I. a

ANN AND EMM UNDER SAME FOOD OFFERED.

	Live wt.: lbs.		*Food consumed: lbs.* Ann.		Emm.		Water drank lbs.		Milk yield lbs.	
Date.	Ann.	Emm.	Hay.	Meal.	Hay.	Meal.	Ann.	Emm.	Ann.	Emm
Nov. 9	968	795	14.1	4	24.6	4	52.7	40.4	8.2	5.8
10	946	771	19.5	4	21.7	4	0	51	8.3	5.4
11	880	771	20	4	22	4	97.7	102.8	9	5.2
12	913	806	20	4	20	4	71.3	61.8	9.3	3.7
13	935	803	18.8	4	19.3	4	52.8	50.8	9.5	5.4
14	933	805	22	4	22	4	83.5	73.3	9.4	6.1
15	953	814	22	4	24	4	71.7	37	10	4.3
16	961	796	22	4	24	4	79	86.2	10.4	4.1
17	970	822	22.2	4	23.6	4	74.2	82	9.6	4
18	966	800	23 6	4	24.8	4	62.8	67.5	10.5	4.4
19	951	814	21.2	4	23.7	4	77.8	56.7	9.8	3.8
20	970	804	24	4	24	4	76.5	71.4	9.7	3.3
21	958	813	12.8	4	20	4	74.4	58.5	10	3.2
22	973	807	19.8	4	20.5	4	56	56.5	9.1	2.5
23	957	811	21.1	4	16.5	4	98.3	33.5	8.4	2.1
24	984	806	21.8	4	22	4	92.6	79.4	6.7	1.1
Mean	951	802	20.3	4	22	4	70	63	9.2	4.0
Nov. 25	994	817	21.5	4	19.4	4	60.4	52.9	7.6	1
26	979	818	21.6	4	19.5	4	85.6	57.3	6.3	0.7
27	984	813	21.5	4	20.3	4	98.8	69	7.7	0.7
28	991	821	22.4	4	22.2	4	123.3	75.8	4	1
29	992	825	22.4	4	22.6	4	113.9	61.2	5.2	0.7
30	991	819	22.2	4	22.5	4	73.5	90	6.3	0.8
Dec. 1	982	827	21.9	4	22.6	4	129.7	62.9	5.3	0.6
2	989	827	23.3	4	22 5	4	108.5	56.4	4.5	0.6
3	986	822	23	4	23.3	4	97.6	75.1	5	0.4
4	991	844	23.7	4	24	4	136	95	5.2	0.3
5	996	858	24.2	4	23.2	4	135.5	86.4	3.8	0
6	1000	855	24	4	23	4	97.8	76.9	4.2	0
7	1000	846	22.6	4	20.7	4	124.7	91.2	3.7	0
8	999	837	23	4	23.4	4	64	69.5	2.8	0
9	1004	839	24.1	4	24.7	4	100.4	111.8	2.8	0
10	1015	864	24	4	23.2	4	113.9	85.5	3.9	0
Mean	993	833	22.8	4	22.3	4	104	76	4.9	0.4
Dec. 11	1000	850	24.4	4	22.9	4	129.3	92.2	2.9	0
12	1000	853	23.8	4	24.3	4	127.3	104.3	3.1	0
13	1003	858	22.2	4	21.2	4	101	85.6	2.6	0
14	994	852	22.6	4	22.1	4	115.4	93.9	3.2	0
15	990	852	22.2	4	22.2	4	107.5	90	2.2	0
16	995	856	21.5	4	22.5	4	104.9	61.6	3.0	0
17	999	854	21.7	4	23.3	4	125.3	97.1	2.4	0
18	986	869	19.9	4	23.7	4	136.9	67.9	2.2	0
19	1002	867	23.7	4	22.7	4	144.7	89.2	2.3	0
20	999	867	23.3	4	23.6	4	130.7	73.9	2.2	0
21	1006	862	22.4	4	23.5	4	142.6	94.5	1.8	0
22	1004	865	17.3	4	22.1	4	128.7	96.2	3.7	0
23	990	868	22.9	4	18.3	4	122.2	73.5	2.2	0
24	1004	857	24.9	4	20.2	4	108.1	63	1.9	0
25	996	857	22.9	4	24.5	4	117.2	73.1	2 2	0
26	1001	874	19.6	4	24	4	127.2	69.1	1.4	0
Mean	998	859	22.2	4	22.6	4	123	82	2.5	0

Food consumed: lbs.

Date.	Live wt. : lbs.		Ann.		Emm.		Water drank : lbs.		Milk yld. lbs.	
	Ann.	Emm.	Hay.	Meal.	Hay.	Meal.	Ann.	Emm.	Ann.	Emm.
Dec. 27	994	874	16.1	4	24.	4	119.7	40.4	1.3	0
28	995	875	22.7	4	24.2	4	127.1	66.3	1.3	0
29	990	890	22.4	4	22.7	4	119.7	80.2	1.7	0
30	995	890	21.5	4	23.3	4	126.2	70.4	1.4	0
31	999	892	23.1	4	22.9	4	129.4	76	0.9	0
Jan. 1	1000	897	13.8	4	21.3	4	84.5	63.1	0.8	0
2	990	880	17.7	4	22.6	4	117	59.7	0.9	0
3	990	883	20.8	4	19.4	4	113.6	73.8	0	0
4	998	876	19.7	4	23.4	4	120.6	76.2	0	0
5	1000	890	24.8	4	24.5	4	134.4	74.4	0	0
6	1022	892	21.6	4	25.1	4	137	53.6	0	0
7	1020	885	20 2	4	23.9	4	93	80.9	0	0
8	1027	905	20.0	4	23	4	119.2	67.7	0	0
9	1002	900	12.7	4	20	4	104.8	48.2	0	0
10	1014*	894	7.5	4	22.9	4	34	49.4	0	0
11	880	901	18.5	4	18.4	4	87.7	66.0	2.5	0
Mean	995	889	19.0	4	22.6	4	110	65	0.7	0
Jan. 12	875	901	19.0	4	15.7	4	89.6	35.1	14.9	0
13	884	890	16.4	4	14.3	4	79.4	37.0	13.8	0
14	894	881	17.1	4	14.6	4	50.2	29.4	14.2	0
15	877	872	21.5	4	22.8	4	77.4	37.2	14.4	0
16	888	886	20.9	4	19.4	4	81.0	41.3	15.5	0
17	893	886	20.6	4	19.5	4	127.5	79.2	15.7	0
18	891	913	19.7	4	18.5	4	109.7	43	16.5	0
19	888	905	18.6	4	18.1	4	105.9	51.1	16.8	0
20	877	910	20.9	4	19.8	4	86.5	33.5	17.5	0
21	869	897	19 7	4	20	4	95.7	66	16.8	0
22	874	924	19.7	4	14.4	4	130.5	37.1	16.5	0
23	885	909	17.5	4	15.8	4	106.6	39.7	16.7	0
24	873	906	18.8	4	17.9	4	99	38.2	16	0
25	859	904	17.8	4	17.1	4	101.9	48.4	16.2	0
26	866	909	19.5	4	18.5	4	123.5	58	16.4	0
27	870	924	19.6	4	18.8	4	113.5	43	15.8	0
Mean	879	901	19.2	4	17.8	4	98	44	15.9	0
Jan. 28	870	917	22.4	4	20.4	4	113	41.9	17.3	0
29	860	915	20.6	4	18.4	4	130.8	53.7	15.5	0
30	873	930	21.2	4	20	4	113.7	38.3	18.9	0
31	862	918	20.6	4	20.2	4	132.8	29.9	15.8	0
Feb. 1	874	917	17	4	16.8	4	101.5	35.3	16.7	0
2	848	908	20.8	4	18.9	4	103.5	64.7	15.1	0
3	855	923	18.3	4	14.9	4	99.5	34.1	14.8	0
4	838	916	15.4	4	17.5	4	60.1	37.7	15.7	0
5	839	913	18.8	4	17.2	4	119.5	59.7	15.1	0
6	836	929	18.6	4	18.2	4	90.2	44.2	14.5	0
7	841	927	22.2	4	20.7	4	99.6	36	14.5	0
8	852	914	21.5	4	18.7	4	103.0	76.2	13.9	0
9	839	937	20.1	4	17.9	4	125.3	53.6	14.4	0
10	841	935	19.4	4	20.4	4	114.7	62.8	16.2	0
11	867	937	23.8	4	21	4	111.2	70.2	16.7	0
12	897	947	19.5	4	22.3	4	103.8	65.6	16.3	0
Mean	856	924	20	4	19	4	107	50	15.2	0

	Live wt. : lbs.		Food Consumed : lbs.				Water Drank lbs.		Milk yield lbs.	
			Ann.		Emm.					
	Ann.	Emm.	Hay.	Meal.	Hay.	Meal.	Ann.	Emm.	Ann.	Emm
Feb. 13	884	945	23.7	4	18.9	4	122.7	25.7	17.4	0
14	894	912	22 9	4	22.2	4	135.3	101.4	17.4	0
15	881	948	22.2	4	19.8	4	122.7	62.2	19 1	0
16	894	947	23.1	4	21.1	4	101.8	66.6	16.1	0
17	884	952	24.1	4	23.7	4	132.4	77.2	18.0	0
18	895	963	23.8	4	19.8	4	112	60.4	18.5	0
19	893	960	24.6	4	22.4	4	120.5	66.2	18.5	0
20	889	957	23.4	4	19.9	4	98.1	65.0	18.9	0
21	879	963	21.5	4	23.5	4	111	31.7	19.9	0
22	891	947	23.2	4	16.0	4	108.7	84.6	19.7	0
23	881	971	23.8	4	20.2	4	115.2	50.2	19.6	0
24	876	966	23.4	4	20.2	4	124	56.4	18.6	0
25	869	954	22.6	4	20.2	4	60.7	38.9	18.5	0
26	861	958	21.6	4	20.7	4	119	75.5	19.5	0
27	876	977	23.2	4	18.1	4	75.5	40.9	17.4	0
28	872	968	22.6	4	23.0	4	107.4	57.5	17.7	0
Mean	882	955	23.1	4	20.6	4	110	60	18.4	0
Mar. 1	867	970	18	4	20.3	4	78	57	17	0
2	865	972	18	4	20.3	4	91.1	71.5	17.2	0
3	867	982	22.7	4	10.0	4	89.5	5.6	17.4	0
4	864	950	22.5	4	12.5	3.1	89.1	46.8	17.8	0
5	871	967	24.1	4	19.6	4	122.5	55.2	17.1	0
6	876	978	24	4	19.6	3.7	112.2	60	18.8	0
7	878	970	22.9	4	15.8	4	126.9	54.1	17.6	0
8	868	972	22.2	4	7.3	4	109.3	15.4	17.9	0
9	874	840*	23.2	4	13.2	4	117.7	83.9	18.1	11
10	871	885	22.4	4	8.4	4	121.9	0	18.5	19.1
11	865	829	22.6	4	20	4	108.9	90.5	19.4	19
12	867	852	24.9	4	11.2	4	128.3	68.2	17.6	22
13	870	852	22.4	4	14.6	4	126.6	41.4	16.9	20.9
14	853	831	24.7	4	19.2	4	130.2	90.8	20.6	22.7
15	877	854	22.9	4	20.7	4	127.7	87.0	18.5	25.5
16	878	859	24.1	4	19.8	4	102.9	84.0	18.5	24.9
Mean	869	910	22.6	4	15.8	3.9	111	57	18.0	10.3
Mar. 17	849	858	22.1	4	21	4	85.1	66.5	18.9	25.2
18	864	846	23.1	4	19.3	4	120.8	79.9	18.7	26
19	874	856	24.2	4	19.8	4	125.2	82.5	18	24.9
20	869	854	24.4	4	14.2	4	125.5	66.5	20.2	24.6
21	870	832	24.2	4	14	4	124.7	57.6	18.2	24
22	867	811	23.8	4	18.9	4	127.9	101.6	19.2	21
23	863	840	23.2	4	17.4	4	131	65	18	22.9
24	868	820	22.6	4	14	4	109.7	49.3	18.9	22.2
25	865	806	23	4	17.1	4	132.7	76.3	17.7	20.7
26	867	813	20.9	4	12.5	3.6	145.4	69.4	16.8	20.8
27	866	795	23	4	16.9	4	128.6	64.3	17.9	20.6
28	866	792	24	4	18.4	2.9	142.9	84.2	16.6	20.1
29	867	785	25	4	17.5	4	139.7	72.5	16	20.5
30	882	800	22.9	4	21.7	4	127	81.7	17.8	22.4
31	891	809	24.7	4	21.6	4	132.1	81.2	17	23.2
Apr. 1	881	810	23.9	4	23.2	4	136.9	88.7	17.6	24.8
Mean	863	820	23.4	4	18.0	3.9	127	79	17.3	22.7

			Food Consumed: lbs.							
	Live wt. : lbs.		Ann.		Emm.		Water drank: lbs.		Milk yld lbs.	
	Ann.	Emm.	Hay.	Meal.	Hay.	Meal.	Ann.	Emm.	Ann.	Emm
Apr. 2	875	799	23.8	4	20.2	4	135.2	41.7	18.2	24.4
3	883	758	23.9	4	21.7	4	141.2	122.5	18	23.9
4	883	790	23.3	4	19.5	4	129.9	74.2	18	24.2
5	872	799	23.9	4	21.9	4	140.1	77.2	17.7	24.8
6	868	789	23.7	4	19.7	4	142	49.8	17.2	22.5
7	875	780	22.5	4	21.9	3.6	97.9	86.5	17 6	22.8
8	856	786	23.3	4	23	4	129.2	75	17.6	25
9	876	785	22.9	4	20.5	4	113.7	26	17.7	25.4
10	869	733	21.1	4	17.6	2.9	116.4	90.7	17.6	21
11	863	763	23.4	4	21.3	2.9	127.6	73.5	16.7	22.3
12	873	773	23	4	21.3	3.6	131.9	77.3	18.8	22.6
13	866	780	21.9	4	20.4	3.6	115.6	84	17.4	22.9
14	870	781	23.3	4	21.9	4	132.7	94.8	17.6	23.4
15	875	781	23.3	4	21.5	4	132.1	109.9	18	25.1
16	870	771	22.9	4	20.8	4	120.9	81.0	17.9	21.5
17	866	764	23.2	4	23.1	4	111.0	95.5	16.8	23.6
Mean	871	777	23.1	4	21.0	3.8	126.1	78.7	17.6	23.4

Ann's calf weighed, when dropped, 64 lbs.

Emm's calf weighed, when dropped, 61 lbs.

TABLE I. b

JEM AND MEG, CHANGED FOOD.

	Live wt. lbs:		*Food Consumed: lbs.* Jem.		Meg.		Water drank lbs.		Milk yield lbs.	
Date.	Lem.	Meg.	Hay.	Meal.	Hay.	Meal.	Jem.	Meg.	Jem.	Meg.
Nov. 9	772	836	24.5	4	23	4	103.1	76.6	8.1	7.8
10	806	843	21.2	4	20.5	4	50.8	0	8.7	8.4
11	785	787	22	4	22	4	84.8	103.2	8.1	9
12	804	843	20	4	20	4	60.9	53.2	9	7.6
13	796	830	19.6	4	16	4	86.7	48	8.5	7.1
14	806	836	22	4	22	4	67.8	79	8.7	7.3
15	804	837	24	4	22	4	55.7	66.1	8.1	7.5
16	790	852	24.3	4	21	4	85.3	62.4	7.3	7.5
17	817	851	23.4	4	23.2	4	70.3	68.1	8	7.5
18	813	854	21	4	21.1	4	68.2	48.5	9.5	7.6
19	809	850	20.8	4	22.7	4	64.6	71.2	7.3	6.9
20	810	856	24	4	24	4	72.3	73.3	7.6	7.2
21	824	863	15.8	4	18.4	4	45.3	56	7.5	7.2
22	813	856	19.5	4	20	4	55.5	72	6.8	6.5
23	794	859	20.2	4	20.9	4	102.3	50.7	6.7	6
24	830	860	19.5	4	21.4	4	56.1	73.7	7.2	6
Mean	805	846	21.3	4	21.1	4	70	62	7.9	7.3
			Hay	Turnips	Hay	Turnips				
Nov. 25	805	860	19.7	30	21.3	30	68.9	55.7	6.8	6.1
26	830	875	18.9	40	18.5	40	18.1	33.8	6.8	5.7
27	800	870	17.7	40	21.4	40	27.8	41	5.7	5.7
28	802	874	19.6	35	19.5	40	61.3	34.5	6.2	5.3
29	819	868	19	40	20	40	61.2	34.5	6.8	5.4
30	824	864	22.2	40	21.7	40	46 1	58.8	7.1	5.5
Dec. 1	808	886	22.5	40	22.2	40	66.9	41	7.3	4.8
2	831	882	23.2	40	21.5	40	52	40.7	7.9	5.7
3	829	879	22.9	40	23	40	52.4	61.2	7.8	5.8
4	824	894	23.9	40	23.3	40	68.6	46	8	5.2
5	842	894	24.4	40	23.3	40	75.8	53.7	7.5	5 7
6	851	898	24.2	40	22.1	40	75.6	55.9	7.7	5.3
7	849	900	23.5	40	20.5	40	50.3	48.8	8	5.5
8	850	897	23.5	40	22	40	10.3	44.2	7.5	5.2
9	846	892	24.5	40	24	40	57.1	51	7.5	5.1
10	848	903	24.7	40	24.2	40	58.7	38.8	8.2	5.7
Mean	827	883	22.1	39	21.8	39	53	46	7.3	5.5
			Hay.	C. S. Meal.	Hay.	C. S. Meal.				
Dec. 11	853	901	24.6	4	23.1	4	79.9	80.5	7.8	5.7
12	849	904	24.5	4	22.8	4	96.2	81.2	6.7	5.2
13	857	913	23.3	4	21.6	4	75.9	72.9	8.4	6.5
14	848	907	23.7	4	22.5	4	84.5	74.6	9.3	5.1
15	847	908	23.2	4	22.2	4	79.1	70.9	9.5	5.8
16	850	901	22.8	4	21.6	4	80.9	77.2	9.2	6.3
17	842	897	24.3	4	21.5	4	95.3	84.9	7.6	5.6
18	855	902	24.6	4	24.2	4	59.2	64.8	9.9	5.3
19	842	904	24	4	24.1	4	93.2	82.7	7.7	5.3
20	870	919	23.7	4	23.7	4	81.2	71.1	8.5	5.1
21	866	913	24	4	21.9	4	71.2	74.7	8.2	4.4
22	853	915	24.4	4	23.2	4	94.2	73.3	8.0	5.4
23	862	912	23.9	4	23.2	4	89.9	79.5	8.7	4.8
24	845	913	24.2	4	22.1	4	107.3	73.2	5.5	4.4
25	853	909	24.3	4	22.7	4	80.5	71.2	8.3	4.8
26	845	903	24.2	4	22.5	4	93.1	80.8	8.2	4.2
Mean	852	907	24	4	22.7	4	85	75	8.2	5.2

	Live wt.: lbs.		*Food Consumed: lbs.* Jem.	Meg.	Water Drank lbs.		Milk yield lbs.	
Date.	Jem.	Meg.	Hay.	Hay.	Jem.	Meg.	Jem.	Meg.
Dec. 27	858	913	27.2	25.5	54.6	60.3	6.2	2.5
28	840	912	22.3	24.2	94.2	76.3	5.6	3.4
29	854	913	26.1	26.1	92.7	88.5	5.1	2.5
30	877	933	23.9	23.9	93.4	73.5	5.7	2.4
31	862	926	25	25.5	89.4	74.1	3.5	1.7
Jan. 1	873	934	25.3	24.1	70.7	61.1	5	1.7
2	855	924	25	20.8	92.7	72.2	2.9	1.6
3	868	926	24	23.4	94	58.7	3.2	0.4
4	877	920	26	23.2	98.6	76.7	4.1	1
5	878	927	24	23.9	99.3	70.9	4.2	0.6
6	875	917	25.8	18.5	76.7	63.2	3.5	0
7	872	910	25.4	22.4	83	64.5	2.7	0
8	877	911	24.4	24	60.7	55	1.8	0
9	882	919	23.4	24.7	76.3	79.1	3.4	0
10	881	932	23.7	22.7	84.1	52.8	0.7	0
11	894	932	22.2	20.9	15.4	64.3	1.7	0
Mean	870	922	24.6	23.3	79	68	3.7	1.1
			Ensilage.	Ensilage.				
Jan. 12	841	931	55.6	54.6	61.8	5.2	1	0
13	870	916	80.4	65.2	0	24.8	1.1	0
14	857	914	80.4	66.5	6.2	0	0.9	0
15	859	910	82.6	60.3	9.2	11.1	0.4	0
16	853	907	87.4	51.2	5.4	10.8	0	0
17	851	909	86.7	29.9	12.7	61	0	0
18	851	851*	80	53.5	2.3	20	0	0
19	851	831	79.4	89	0	11.8	0	2.9
20	848	824	80	80	0	4	0	13.6
21	851	802	80	77.7	7.2	0	0	12.1
22	843	799	108.4	104.2	0	0	0	13.5
23	873	811	90.4	90.7	0	0	0	14.5
24	854	820	81.3	82.8	0	0	0	13.9
25	856	807	51.6	93.2	12.6	0	0	13.0
26	773*	811	80.8	94	44.5	3.8	6.2	14.1
27	811	800	80.5	83.5	23.1	0	10	12.4
Mean	846	856	80.3	73.5	11.6	9.5	1.2	6.9

	Live wt.: lbs.		*Food Consumed: lbs.* Jem.		Meg.		Water drank lbs.		Milk yield lbs.	
Date	Jem.	Meg.	Meal.	Enslg.	Meal.	Enslg.	Jem.	Meg.	Jem.	Meg.
Jan. 28	787	798	4	81.6	4	82.5	11.1	0	16.3	14.1
29	775	808	4	85.2	4	85.2	11.5	0	17.8	13.2
30	770	802	4	88.7	4	85.9	16.7	0	19	14
31	768	804	4	81.5	4	79.8	16.8	7.6	20.5	13.5
Feb. 1	777	803	4	79.8	4	74.8	16.4	0	21.3	14
2	768	799	4	75.2	4	85.4	11.6	0	19.7	13
3	751	793	4	74.2	4	77.7	1.4	0	20.6	14.3
4	746	783	4	80	4	78.3	13.5	0	21	13.5
5	750	769	4	88.1	4	89.2	13.8	0	20.5	14.1
6	740	773	4	86.4	4	90	4.1	0	20.8	13.9
7	741	758	4	89.1	4	96.2	21.2	0	21.1	12.5
8	740	775	4	82.6	4	88.6	12.3	0	20.9	14
9	734	771	4	85.3	4	95.6	29.2	3.9	21.4	13.9
10	717	774	4	91.5	4	97.8	53.5	26.6	21.2	14.2
11	739	783	4	89.4	4	92.0	63.2	27.4	20.3	14.6
12	742	786	4	82	4	93.0	48.8	12.6	21	14.1
Mean	753	786	4	83.8	4	87.0	21.6	4.9	21.5	13.8

Food Consumed: lbs.

	Live wt. : lbs.		Jem.		Meg		Water drank lbs.		Milk yield lbs.	
1886.	Jem.	Meg.	Hay.	Meal.	Hay.	Meal.	Jem.	Meg.	Jem.	Meg.
Feb. 13	723	783	20.9	4	20	4	21	41	22.9	14.3
14	670	753	21	4	21.4	4	116.9	81	21.4	12
15	717	760	20	4	21.9	4	79.6	81.5	23.4	15.9
16	719	765	20.5	4	22.2	4	78.7	71.1	21.4	15.6
17	718	766	21.7	4	22.8	4	85.8	90.2	21.5	14.8
18	728	779	21.9	4	22.6	4	101	82.3	21.7	15.3
19	745	782	22.4	4	23.1	4	75.5	69.4	21	16
20	745	778	22.9	4	23.1	4	77.1	72.5	22.4	15.2
21	736	778	23.2	4	21.9	4	83.9	79.9	22.6	16
22	738	782	23.8	4	22.5	4	89.6	89.5	23.5	17.2
23	746	786	23	4	23	4	104.2	85.9	23.3	16.2
24	760	790	22.2	4	18.7	4	89.2	80	22.2	16.9
25	757	782	21	4	22.4	4	75.4	67.8	22	17.4
26	754	773	23.3	4	21.7	4	71	70.5	22	16.6
27	753	768	23.1	4	23.9	4	99	86.9	22.8	16.4
28	751	782	23.4	4	23.4	4	83	83.8	22.2	15
Mean	735	775	22.1	4	22.1	4	83	77	22.3	15.7
			Hay.	Turnips.	Hay.	Turnips.				
Mar. 1	736	783	18.3	20	18.1	20	57.8	60.2	21.4	14.8
2	728	782	21.3	20	21.1	20	49.2	79.5	20.2	14.6
3	721	788	20.9	20	21.4	20	88.6	69.5	21.7	14.7
4	736	795	22.7	20	18.4	20	35.2	66.7	22	14.5
5	720	790	23.1	20	22.1	20	125.0	77	21.9	15
6	744	798	23.4	20	21.9	20	65.8	68.9	21.4	15.2
7	744	800	23.7	20	22	20	59.6	62.7	21.9	14.9
8	736	792	21.6	20	16.4	20	70.5	74.5	22	14.7
9	745	789	22.7	20	23.7	20	57.7	66.9	21.4	16
10	736	795	23.9	20	23	20	69.9	65.4	22.2	15.5
11	736	796	23.7	20	22.7	20	60.9	69.9	22.3	14.7
12	735	796	24.4	20	23.1	20	73.5	80	23.1	15.3
13	735	806	24.7	20	22.3	20	80.3	70.6	23	16.9
14	744	805	24.8	20	22.9	20	82.2	77.6	22.9	16.4
15	743	812	24.6	20	22.7	20	92	87.7	23.8	16.7
16	757	819	23.2	20	20.5	20	67.7	67.4	24.5	16.9
Mean	737	796	22.9	20	21.4	20	71	71	22.1	15.4
			Hay.	C. S. Meal.	Hay.	C. S. Meal.				
Mar. 17	749	819	25.1	4	24	4	100.3	76.4	23.6	16.4
18	749	804	25.6	4	23	4	100.4	106.6	26.6	19.1
19	760	820	25.6	4	23.7	4	89.5	71.9	27.5	19.7
20	749	801	25.4	4	24.6	4	108.4	104.9	28.4	20.3
21	757	812	25	4	20.6	4	109	84.4	28.1	20.2
22	760	805	23.8	4	21.9	4	106.3	84	29.3	20.2
23	747	799	24.9	4	23.6	4	103.9	87.3	28.5	20.5
24	754	803	24.7	4	24.4	4	78.3	80.6	27.1	19.5
25	750	810	24.6	4	21.8	4	98.7	81.2	27	19.8
26	756	808	24.2	4	24	4	96.7	86.3	27.5	19.8
27	754	813	25	4	23.5	4	92.1	80.2	27.1	19.2
28	756	803	24.8	4	24.6	4	103	91.7	26	19.4
29	760	810	23.5	4	24.2	4	77.7	99.7	25.5	19.7
30	763	826	24.6	4	22.6	4	106.9	98.5	26	20.5
31	772	822	24.6	4	23	4	107.4	102.9	27.4	20.5
Apr. 1	764	821	23.5	4	23.9	4	109.6	85.7	28.6	20.9
Mean	756	811	24.7	4	23.3	4	99	89	27.1	19.7

	Live wt.: lbs.		*Food Consumed: lbs.*		Water drank lbs.		Milk yield lbs.	
			Jem.	Meg.				
Date.	Jem.	Meg.	Hay.	Hay.	Jem.	Meg.	Jem.	Meg
April 2	765	825	29.5	27.6	95.5	80.7	27.1	23.6
3	767	821	27.4	27.4	66	88.9	23.7	19
4	759	824	27.4	24.8	102.4	82.6	23.9	18.6
5	768	820	26.7	26.6	123.1	91.9	23.5	18
6	784	825	22.7	23.6	73	70.6	21.6	16.9
7	766	816	25.4	24.7	107.5	98.4	22.1	17.3
8	767	825	27.4	27.9	87.3	71.1	22.4	17.7
9	759	811	27.8	28	85.5	108.1	21.7	17
10	760	818	25.3	25.1	111.1	95.2	21.9	17.3
11	776	824	25	23.1	86.9	64.3	22.4	17.4
12	776	800	28.7	22.7	104.5	90.3	21	16.4
13	780	813	27.3	29.4	104.4	82.7	21.9	16.6
14	776	805	26.2	28.4	116.1	105.6	21.4	16.1
15	777	824	25.9	21.2	120.7	101	21.4	16.4
16	780	825	27.6	27.6	97	70.5	19.6	15.6
17	761	802	27	27.2	119.9	107.5	20.4	14
Mean	770	817	26.7	26	100	88.1	22.2	17.4

Jem's calf weighed, when dropped, 46 lbs.

Meg's calf weighed, when dropped, 64 lbs.

TABLE II. a

DAILY AVERAGES: SAME FOOD.

Food Consumed: lbs.

1885–6	Av. live wt. lbs.		Ann.		Emm.		Water drank lbs.		Milk yield lbs.	
	Ann.	Emm.	Hay.	Meal.	Hay.	Meal.	Ann.	Emm.	Ann.	Emm
Nov. 9–14	929	792	19	4	21.6	4	59.6	63.3	8.9	5.3
15–19	960	809	22.2	4	24	4	73.1	65.9	10	4.1
20–24	968	808	19.9	4	20.6	4	79.5	59.8	8.8	2.4
25–30	988	819	21.9	4	21.1	4	92.6	67.7	6.2	0.8
Dec. 1– 5	989	836	23.2	4	23.1	4	121.4	75.2	4.7	0.4
6–10	1003	848	23.5	4	23	4	100.1	87	3.5	0
11–16	997	853	22.8	4	22.5	4	114.2	87.9	2.8	0
17–21	998	864	22.2	4	23.3	4	136	84.5	2.2	0
22–26	999	864	21.5	4	21.8	4	120.7	75	2.3	0
27–Jan.1	995	886	19.9	4	23.1	4	117.7	66	1.2	0
Jan. 2– 6	1000	884	20.9	4	23	4	124.5	67.5	0.2	0
7–11	988*	897	15.8	4	21.6	4	87.7	62.4	0.5	0
12–17	885	886	19.2	4	17.7	4	84.2	42.2	14.8	0
18–22	880	910	19.7	4	18.1	4	105.6	46.1	16.8	0
23–27	871	910	18.6	4	17.6	4	108.9	45.4	16.2	0
28–Fb.2	865	918	20.4	4	19.3	4	115.9	43.9	16.5	0
Feb. 3– 7	842	921	18.6	4	17.7	4	93.8	42.3	14.9	0
8–12	859	934	20.8	4	20.1	4	111.6	65.7	15.5	0
13–18	889	944	23.3	4	20.9	4	121.1	65.6	17.7	0
19–23	889	959	23.3	4	20.4	4	110.7	59.5	19.3	0
24–28	871	965	22.7	4	20.4	4	97.3	53.8	18.3	0
Mar. 1– 6	868	969	21.5	4	17.0	4	97.1	49.3	17.5	0
7–11	871	899*	22.6	4	12.9	4	116.9	48.8	18.3	9.8
12–16	869	849	23.8	4	17.1	4	123.1	74.3	18.4	23.2
17–22	865	843	23.6	4	17.9	4	118.2	75.8	18.9	24.3
23–27	858	815	22.5	4	15.6	4	129.5	64.9	17.8	21.4
28-Apr. 1	877	799	24.1	4	20.5	3.8	135.7	83.1	17.0	22.2
Apr. 2– 7	876	786	23.5	4	20.8	3.9	131	75.3	17.8	23.7
8–12	867	768	22.7	4	20.7	3.5	123.7	68.5	17.7	23.3
13–17	869	775	22.9	4	21.5	3.9	122.5	93.0	17.5	23.3

TABLE II. b

DAILY AVERAGES: CHANGED FOOD.

	Live wt.: lbs.		Jem.		Meg.		Water drank lbs.		Milk yield lbs.	
1885-6	Jem.	Meg.	Hay.	Meal.	Hay.	Meal.	Jem.	Meg.	Jem.	Meg.
Nov. 9–14	795	829	21.5	4	20.6	4	75.7	60	8.5	7.9
15–19	807	849	22.7	4	22	4	68.8	63.3	8	7.4
20–24	814	859	19.8	4	20.9	4	66.3	65.1	7.1	6.6
			Hay.	Turnips.	Hay.	Turnips.				
25–30	813	868	19.5	37.5	20.4	38.3	47.2	43	6.5	5.6
Dec. 1– 5	827	887	23.4	40	22.6	40	63.1	48.5	7.7	5.4
6–10	849	898	24.1	40	22.5	40	49.2	47.7	7.8	5.3
			Hay.	C. S. Meal.	Hay.	C. S. Meal.				
11–16	851	906	23.7	4	22.3	4	82.7	76 2	8.4	5.8
17–21	855	907	24.1	4	23.1	4	82	75.6	8.4	5.1
22–26	852	910	24 2	4	22.7	4	93	75.6	7.7	4.7
			Hay.		Hay.					
Dc. 27–Jn. 1	861	922	25		24.9		82.5	72.3	5.2	2.4
2– 6	871	923	24.9		21.9		91.6	68.3	3.6	0.7
7–11	881	921	23.8		22.9		63.9	63.1	2.1	0
				Ensilage.		Ensilage.				
12–17	855	914		78.8		54.6	15.9	18.8	0.7	0
18–22	849	821*		85.5		82.9	1.9	7.1	0	8.4
23–27	833*	810		76.1		88.8	16	0.7	3.2	13.6
			Meal.	Ensilage.	Meal.	Ensilage.				
28–Feb. 2	774	802	4	80.3	4	82.2	14	1.3	19.1	13.6
Feb. 3– 7	745	775	4	83.5	4	86.3	10.8	0	20.8	13.6
8–12	734	778	4	86.1	4	93.4	41.5	14.1	20.9	14.1
			Hay.	Meal.	Hay.	Meal.				
13–18	712	768	21	4	21.8	4	80.5	74.5	22	14.6
19–23	742	781	23.1	4	22.7	4	86.1	79.4	22.5	16.1
24–28	755	779	22.6	4	22	4	83.5	77.8	22.2	16.5
			Hay.	Turnips.	Hay.	Turnips.				
Mar. 1– 6	731	789	21.6	20	20.5	20	70.2	70.3	21.4	14.8
7–11	739	794	23.1	20	21.5	20	63.7	67.9	21.9	15.1
12–16	743	807	22.3	20	22.3	20	79.1	76.6	23.4	16.4
			Hay.	C. S. Meal.	Hay.	C. S. Meal.				
17–22	754	810	25.1	4	22.9	4	102.3	88	27.2	19.5
23–27	754	807	24.7	4	23.5	4	93.9	83.1	27.4	19.8
28–Apr. 1	763	816	24.2	4	23.6	4	100.9	95.7	26.7	20.2
			Hay.		Hay.					
Apr. 2– 7	768	822	26.5		25.8		94.6	85.5	23.6	18.9
8–12	767	816	26.8		25.3		95.1	85.8	21.9	17.1
13–17	775	814	26.8		26.7		111.6	93.5	20.9	15.7

TABLE III. a

DAILY AVERAGES FOR SIXTEEN DAY PERIODS.

SAME FOOD.

Food Consumed: lbs.

	Live wt.: lbs.		Ann.		Emm.		Water drank lbs.		Milk yield lbs.	
1885–6	Ann.	Emm.	Hay.	Meal.	Hay.	Meal.	Ann.	Emm.	Ann.	Emm
Nov. 9–24	951	802	20.3	4	22	4	70	63	9.2	4.0
25–Dec. 10	993	833	22.8	4	22.3	4	104	76	4.9	0.4
Dec. 11–26	998	859	22.2	4	22.6	4	123	82	2.5	0.0
27–Jan. 11	995*	889	19.0	4	22.6	4	110	65	0.7	0.0
12–27	879	901	19.2	4	17.8	4	98	44	15.9	0.0
28–Feb. 12	856	924	20.0	4	19.0	4	107	50	15.2	0.0
13–28	882	955	23.1	4	20.6	4	110	60	18.4	0.0
Mar. 1–16	869	910*	22.6	4	15.8	3.9	111	57	18.0	10.3
17–Apr. 1	863	820	23.4	4	18.0	3.9	127	79	17.3	22.7
2–17	871	777	23.1	4	21.0	3.8	126	78	17.6	23.4
Mean	915	867	23.5	4	20.1	4	108	65	11.9	6.1

TABLE III. b

CHANGED FOOD.

Food Consumed: lbs.

	Live wt.: lbs.		Jem.		Meg.		Water drank lbs.		Milk yield lbs.	
1885–6	Jem.	Meg.	Hay.	Meal.	Hay.	Meal.	Jem.	Meg.	Jem.	Meg
Nov. 9–24	805	846	21.3	4	21.1	4	70	62	7.9	7.3
25–Dec. 10	827	833	Hay. 22.1	Turnips 39	Hay. 21.8	Turnips. 39	53	46	7.3	5.5
11–26	852	907	Hay. 24	C. S. Meal. 4	Hay. 22.7	C. S. Meal. 4	85	75	8.2	5.2
27–Jan. 11	870	921	Hay 24.6		Hay. 23.3		79	68	3.7	1.1
12–27	846*	856*		Ensilage. 80.3		Ensilage. 73.5	11	9	1.2	6.9
28–Feb. 12	753	786	Meal. 4	Enslg. 83.8	Meal. 4	Enslg. 87	21	5	21.5	13.8
13–28	735	775	Hay. 22.1	Meal. 4	Hay. 22.1	Meal. 4	83	77	22.3	15.7
Mar. 1–16	737	796	Hay. 22.9	Turnips. 20	Hay. 21.4	Turnips. 20	71	71	22.1	15.4
17–Apr. 1	756	811	Hay. 24.7	C. S. Meal. 4	Hay. 23.3	C. S. Meal. 4	99	89	27.1	19.7
2–17	770	817	Hay. 26.7		Hay. 26.0		100	88	22.2	17.4

TABLE IV. a

Daily Albuminoid Consumed.

Period.		Ann. lbs.	Emm. lbs.	Mean. lbs.
I.	Hay and meal.	1.37	1.46	1.41
II.	"	1.49	1.47	1.48
III.	"	1.46	1.48	1.47
IV.	"	1.31	1.48	1.39
V.	"	1.32	1.25	1.28
VI.	"	1.36	1.32	1.34
VII.	"	1.51	1.39	1.45
VIII.	"	1.48	1.15	1.31
IX.	"	1.52	1.26	1.39
X.	"	1.51	1.41	1.46

TABLE IV. b

		Jem.	Meg.	
I.	Hay and meal.	1.42	1.41	1.41
II.	Hay and turnips.	1.55	1.54	1.54
III.	Hay and cotton seed meal	2.82	2.77	2.79
IV.	Hay.	1.18	1.12	1.15
V.	Ensilage.	.74	.68	.71
VI.	Meal and ensilage.	1.17	1.20	1.18
VII.	Hay and meal.	1.46	1.46	1.46
VIII.	Hay and turnips.	1.35	1.28	1.31
IX.	Hay and cotton seed meal	2.86	2.79	2.82
X.	Hay..	1.29	1.25	1.27

The merest inspection of these tables indicates the influence of gestation upon the interpretation of the effect of food consumed, and suggests the division of our study into two heads: the one "before calving," the other "after calving." We may also study the tables in two series, *a*, or under uniform feeding; *b*, or under changed feeding.

By referring to table III *a*, where the periods are sufficiently long to eliminate the daily variations in weight, we observe that before calving there was a gradual increase of live weight; after calving irregularity in the weights, one cow decreasing, the other cow sometimes gaining.

By referring to Table III *b*, we note that under changed feed, before the calvings, there is an increase in live weight, after calving an increase also.

By referring to Table II, *a* and *b*, we note the following facts:

Name of cow.	Gain in live wt. Equal periods before calving.	Weight of calf at birth: lbs.	Average milk yield: lbs. per day.
Ann	71 lbs.	64	4.6
Emm	72 lbs.	61	0.0
Jem	36 lbs.	46	5.3
Meg	55 lbs.	64	3.8

Ann ceased milking 7 days before calving.
Emm ceased milking 61 days before calving.
Jem ceased milking 10 days before calving.
Meg ceased milking 13 days before calving.

By referring to Table III, *a* and *b*, we note the average live weights for like periods before calving, as below:

	Av. live wt. during each period of 16 days: lbs.			
		Gain.	Gain.	Gain.
Cows under uniform feed	920	947 (27)	961 (14)	977 (16)
" " changed feed	825	855 (30)	879 (24)	896 (17)

These figures can only be interpreted to mean that sufficiency of food, rather than any peculiarity of the ration, is the principal requirement during the latter stages of gestation, and that the growth of the foetus must be satisfied before the increase of live weight can be interpreted as gain in the cow.

The variations in the figures must come partly from the individuality of the cows: referring to Table III, we note that while Ann drank 99 lbs. of water daily on the average, Emm drank but 51 lbs., Jem 72 lbs., and Meg 63 lbs. During the first period, on hay and meal feeding, all the cows consumed 4 lbs. of meal each, daily, but of the hay Ann consumed 20.3 lbs., Emm 22 lbs., Jem 21.3 lbs. and Meg 21.1 lbs., or practically like amounts.

Under the hay and meal feeding we note quite a close relationship between live weight, albuminoid consumed and milk yield; under changed feed the relationship is not as well marked, as the influence of the preceding food offers a disturbing factor.

An examination of Table IV, *a* and *b*, shows that there was quite a variation in the amount of albuminoid consumed during each period, the excessive amount during Periods III and IX being very noticeable. During the first of these periods, before calving, the two cows gained scarcely at all in live weight, and fell off in milk far less than the increase of time from calving would lead one to expect; during Period IX, after calving, the cows increased slightly in weight, and maintained an even milk flow. As compared with the preceding and following periods, Periods III and IX indicate a large gain in milk, which must be credited to the influence of the cotton seed meal. It will be noticed that the feeding of the cotton seed was accompanied by an increased hay consumption, and an increased amount of water drank.

It will be further noted that there seems to be no especial relation between the amount of water drank and the yield of milk.

The effect of the meal ration is scarcely perceptible, as compared with the hay ration, according to the data, but the experiment is scarcely satisfactory in this interpretation: but,

The two cows:

Period VII.	Gaining ration....22.1 lbs. hay	4 lbs. meal.	19 lbs. milk.
" X.	Maintenance ration. 26.3 " "		19.8 " "

Or for latter third of these periods, when the influence of the preceding food may be thought to have been eliminated,

The two cows:

Period VII.	Gaining ration	22.3 lbs. hay.	4 lbs. meal.	19.3 lbs. milk
" X.	Maintenance ration	26.7 " "		18.3 " "

Or under the hay and milk yield gained slightly towards the close of the period, and under hay lost slightly in weight.

I fear the experiment was not sufficiently well planned to enable us to deduce many certain conclusions. We may, however, say that corn meal seems to have but little specific effect upon the yield of milk, while cotton seed meal seems to have a marked effect upon the milk yield. Yet even here we may be deceived in this conclusion as the results may come from the increased amount of albuminoid consumed, as is indicated by the following summary of the last third of each period. See Table II. b.

		Av. daily milk yield: lbs.	Av. daily albuminoid consumed lbs.
Table III. a.	Period IX	20.0	1.39
	X	20.5	1.46
Table III. b.	Period VI	17.6	1.18
	VIII	18.7	1.31
	VII	19.0	1.46
	X	19.8	1.27
	IX	23.4	2.82

RELATION BETWEEN TEMPERATURE AND CROPS.

The relations between temperature and growth are quite close, and the mean temperature of the cycle in which crops vegetate and ripen becomes instructive as indicating the useful plants which may succeed in a given locality. If we investigate the mean temperatures at the Station during the several years of occupancy, and examine into the yields of each year, we may observe relations which are of interest to the farmer. For the purpose of attaining a correct idea of the mean temperature, we take that of the soil; and as a further guide take the average of the extreme temperatures of each day, by which we form the following table.

	Mean soil temperature, 1 to 9 in. deep.				
	1882.	1883.	1884.	1885.	1886.
	°	°	°	°	°
June	62.16	62.95	70.62	68.36	68.73
July	67.15	65.85	69.85	73.20	72.26
August	67.86	63.55	71.43	67.51	70.84
June and July	64.65	64.40	70.23	70.78	70.53
July and August	67.51	64.70	70.64	70.36	71.54
June, July and August	65.72	64.12	70.53	69.69	70.63

Mean of maxima and minima air thermometers.

	1882.		1883.		1884.		1885.		1886.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
June	75.8	54.7	76.1	56.6	78.6	55.2	74.1	53.0	75.1	53.2
July	80.0	58.4	77.2	57.6	75.5	57.1	79.5	59.8	78.7	57.2
August	80.1	58.0	76.1	55.0	81.5	58.2	73.7	56.3	77.4	57.4
June and July	77.9	56.5	76.6	57.1	77.0	56.1	76.8	56.4	76.9	55.2
July and August	80.0	58.2	76.6	56.3	78.5	57.6	76.6	58.0	78.1	57.3
June, July, Aug.	78.6	57.0	76.5	65.4	78.5	56.8	75.8	56.4	77.1	55.9

The average yield of corn, as recorded for plats treated alike during four of these years, was

	Average corn crop.		
1882	50.2	bushels	per acre.
1883	58.6	"	"
1884	63.8	"	"
1885	58.8	"	"

The figures of crop are not absolute, as the water contents at harvest vary greatly, and hence the crop in an unfavorably cool year is recorded as larger than it really is in comparison with a well ripened harvest.

In 1882 the corn was fairly ripe ; in 1883 rather moist but could be safely binned ; in 1884 well ripened ; in 1885 very moist and had to be moved in the bin to prevent moulding.

In 1882, 76 lbs. of ear corn made a bushel of shelled corn; in 1883 it required 80 lbs. In 1884, a sample analyzed 34 per cent. of water. In our report of crops we have calculated to 80 lbs. of ear corn to the bushel.

In 1883 and 1885, the mean of the maxima temperatures of July and August the same, viz: 76.6; the crop the same, viz: 58.6 and 58.8 bushels, and these years of unripeness. In 1882 and 1884, the correspondences between crop and temperature do not seem to obtain except as between the two years. The figures show:

	1883.	1885.	1882.	1884.
Mean soil temp. Aug.	63.5	67.5	67.8	71.4
Mean max. temp. Aug.	76.1	73.7	80.1	81.5
Crop harvested, bushels	58.6	58.8	50.2	63.8

Notwithstanding the discrepancy in 1882, the figures seem to suggest that there is a close relation between temperature and crop, and that corn requires a high mean temperature, and high maximum temperatures for its best yield.

With potatoes, our experience shows the following relations between temperature and crop, the variety being the same, and the conditions being as nearly alike as we could select from our data. In 1885, a season of rot, the figures are somewhat under the real yield for the purposes of this comparison

	1883.	1884.	1885.	1886.
Mean soil temperatures, June, July, Aug.	64.1	70.5	69.7	70.63
Average crop, single eyes for seed, bus.	314	183	169	128

We thus infer that a cool temperature of the soil is advantageous to the yield of potatoes, and that a cool season is favorable to this crop.

So far as our present experience justifies, we can assert that the character of the season is more determining in its effects, than the quantity of fertilizer used.

SEED CORN.

Last year we determined the fact that in our trials the kiln drying of seed corn increased greatly its value and certainty for seed purposes. Other experiments at that time indicated a larger germinating quality in corn that was kiln-dried in the best selected corn of the same variety from the crib.

This spring, experiments in the same line did not indicate the same difference in germinative properties, the seed having been dried only immediately preceding the trial, but what is more important, they have indicated the greater vigor of the plant which is grown from kiln-dried seed. While in germination, in one trial, the vitality as expressed in per cents was precisely the same as between two lots of 500 seeds each, the one corn from the crib, and the other thoroughly dried over a radiator, viz. 94 per cent., yet when this same corn was planted in the earth the difference became very marked, the corn from the crib giving but twenty per cent. vegetation, and the same corn kiln-dried giving 80 per cent. vegetation. The difference was even more marked in the growth, the corn from the crib only attaining a height of three inches, while that from the kiln-dried seed had reached the height of five inches in the same time.

While it is not safe to generalize from single instances or from few trials, yet these results are sufficiently striking to justify us in calling the attention of farmers to this point, as there is always a large loss in practical farming arising from the non-germination of seed and vacant spaces which would have been filled provided the seed had been of the best quality.

The advice so frequently given in our press, of selecting seed corn is very proper, as selection is one of the most important agencies we have toward improving the quality of our cereals and vegetables, but it is an experience of ours whose truth cannot be questioned, that as between two samples of equally fresh seed preserved under different circumstances, there may be a very wide difference in germinative and vegetative properties, and that freshness of seed alone, and careful selection alone, is not sufficient in every case to furnish the best results. In addition, the method of preserving the seed must be considered as of importance, for our trials with seeds of primarily equally good quality indicate that seed which is most carefully preserved and kept over, will not only retain its vitality longer, but will also give better results in planting. It is certainly good advice, and advice which it is well for the farmer to heed, to select carefully his seed corn from his bin, or better still, from the field, and to carefully keep over to the next season in a warm and dry place. At the present time the advice is certainly justified, by the facts at our command, for the farmer to select his seed corn by taking the best ears, and after shelling, or in the ear, to put in a warm place and allow to thoroughly dry before using in the spring.

Seed corn, when planted too early, is often destroyed in the ground. This destruction does not come from the cold, as often assumed, but from other conditions, the most important of which is the slow germination of the seed and a vitality which cannot endure this circumstance, and also the action of mold, which grows rapidly at a lower temperature than will suffice for the corn. It therefore holds good in practice that to those who plant early the very best of seed is of great importance; and what adds value to this reflection is, that, so far as our data warrants, we can state with considerable certainty that early planted corn will usually yield a larger crop than will the same variety planted at a late period.

The loss to the farmers of the state from the use of seed corn, which is not as good as it might be, is enormous. During the present year observation has shown many fields where the vacancies could be estimated at 40, 50 and even 60 per cent., and in which the crop was thereby reduced. If these farmers had recognized the importance of drying their seed, much of this loss might have been prevented. I think I am safe in saying that on thousands of acres the yield was diminished twenty per cent. by the use of seed that by thorough drying might have given eighty per cent. of plants. A little thing this, the keeping of seed corn in a warm place until thoroughly dried, and yet the gain in the aggregate crop of the state would be large if farmers would only attend to these seeming littles.

CORN—PREPARATION OF THE LAND.

Plats B. 6 to 9, one-tenth of an acre each, were planted with Waushakum corn, the conditions being kept alike, all except the preparation of the land. B. 6 was ploughed and lightly harrowed and then planted; B. 7 was ploughed, thoroughly harrowed, and planted: B. 8 was ploughed, harrowed, rolled, again harrowed, and planted; B. 9 was harrowed, rolled, harrowed, planted and then rolled after planting. The hills were 44x44 inches, and six kernels to the hill, which after vegetation were thinned, the plants in excess over four being removed. The figures :

	No. of plants.	Merchantable.			Unmerchantable.		
		Ears.	Weight.		Ears.	Weight	
			lbs.	ozs.		lbs.	ozs.
B. 6	693	961	362	7	327	34	8
B. 7	847	1257	423	5	271	27	2
B. 8	901	1098	425	13	289	27	6
B. 9	954	1357	440	1	176	17	8

The actual yield per acre was as below :

	Yield per acre, bushel. Actual yield.
B. 6	45.3
B. 7	52.9
B. 8	53.2
B. 9	55.0

This in the number of plants, and in the actual yield, probably represents an influence arising from the treatment of the land before planting, the better seed bed securing a better stand.

CORN—TREATMENT OF THE SEED.

The various rows upon two 1-10 acre plats B. 10 and 11 of presumed uniformity were planted differently. The results secured are expressed, together with other data, in the following tabulation :

		No. of plants.	Merch. corn.		
			No. of ears.	Weight.	
				lbs.	ozs.
4 rows.	Seed covered loosely	364	442	165	7
4 rows.	Soil tapped with hoe	419	516	198	1
4 rows.	Soil trodden on	379	485	180	0
4 rows.	Soil struck with maul	379	512	186	10

The planting was on May 12. On May 13 we had .60 inches of rain ; on May 15 we had .13 inches, and on May 16, .18 inches. These rains consolidated the soil about the seed, and destroyed the effort to ascertain the influence of the firming of the soil. The results, however, may be interpreted as slightly in favor of the compression of the soil. On a large scale we have frequently noted the effect of bringing the soil into contact with the seed by stepping upon the hill after planting, or striking with the hoe, and a farm experience has shown that the gain in germination through using a corn planter whose wheel ran over the planted hill was sufficient alone to justify the purchase of the machine, as over hand planting.

DISTANCE OF PLANTING.

We made a few trials upon distance of planting, or hills vs. drills. The results are given below:

		Yield per acre.
F. 16.	6 plants per foot, drills 44 in. apart	47.2 bushels.
F. 18.	12 " " " " "	17.7 "
F. 20.	12 " " drills 88 in. apart	25.1 "
F. 17.	Hills 44x44 in	47.9 "
F. 19.	" " "	26.8 "
F. 21.	" " "	38.1 "

These are the actual yields, and are not corrected to allow for the vacant spaces through imperfect seeding. The actual number of plants per twentieth acre plats, and number of ears, etc., was as below:

		Merch. corn.		Unmerch. corn.	
	No. of plants.	No. of ears.	Weight of ears.	No. of ears.	Weight of ears.
F. 16	2441	908	188–12	466	13–2
F. 18	4976	476	70–14	1326	76–10
F. 20	2812	569	100–5	781	55–14
F. 17	607	574	191–11	127	11–15
F. 19	559	404	107–7	160	13–5
F. 21	594	495	152–4	174	14–7

We cannot escape the conclusion that too thick planting is injurious to crop. Although F. 16 and F. 17 furnish crop of nearly equivalent yield, yet the ear averages 3.3 ounces in F. 16 and 5.3 ounces in F. 17.

The 12744 merchantable ears grown on 21 plats (1.05 acres) given in our 1885 report, p. 43, averaged 5.69 ozs. As the division into merchantable and unmerchantable ears were made up by those who were unacquainted with the object of the separation, these weights may be taken as representing the average weight per ear of Waushakum corn ready for market.

The plats planted with corn, and under different treatments as regards fertilizer applied were nearly duplicates, as regards previous treatment during the years 1883, 1884 and 1885. Thus the plats E. 6, 7, 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20 had received 400 lbs. per acre of the same phosphate each of the three years; E. 8, 9 and 10 had received 400 lbs. phosphate during two years, and none in 1884. The F. series, however, had been fertilized as below:

	1883.	1884.	1885.
F. 13	No fert.	1000 lbs. phos. per a.	No fert.
F. 14	No fert.	960 lbs. mur. pot. per a.	No fert.
F. 15	No fert.	1120 lbs. sulph. pot. per a.	No fert.
F. 17	No fert.	No fert.	400 lbs. phos. per a
F. 19	No fert.	No fert.	No fert.
F. 21	No fert.	400 lbs. phos. per a.	No fert.

The following table represents the harvest figures for each plat of one-twentieth of an acre, the star attached representing the areas of like fertilization for the three years preceding this trial.

			Merch.			Unmerch.		
		No. of plants.	No. of ears.	Weight. lbs.	ozs.	No. of ears.	Weight. lbs.	ozs
E. 10.	No fertitizer	627	604	227	5	119	12	3
*E. 18.	“	594	589	207	2	89	8	2
*E. 6.	400 lbs. acid phos. per a	626	591	221	9	158	15	11
E. 9.	“ “	615	620	238	14	122	11	0
*E. 17.	“ “	628	585	218	10	139	13	13
F. 14.	“ “	613	647	249	1	114	9	7
F. 17.	“ “	607	574	191	11	127	11	15
F. 19.	“ “	559	404	107	7	160	13	5
F. 21.	“ “	594	495	152	4	174	14	7
*E. 20.	800 lbs. acid phos. per a	609	498	169	6	140	10	8
*E. 7.	100 lbs. nitrate soda per a	615	646	242	15	116	10	0
*E. 16	200 “ “	589	508	181	14	180	17	9
E. 8.	100 lbs. sulph. ammonia per a	622	615	232	15	122	12	5
*E. 15.	200 “ “	603	617	235	4	111	12	0
*E. 11.	50 lbs. nit. soda, 50 lbs. sulph. am. per a	620	653	249	6	159	13	13
*E. 12.	“ “ “ “	623	671	252	10	91	8	7
*E. 13.	400 lbs. acid phos., 100 lbs. nit. soda per a	622	638	246	8	116	10	2
F. 13.	400 lbs. acid phos., 200 lbs. nit. soda per a. the nitrate applied when plants were 1 foot tall	610	710	281	15	152	13	14
F. 15.	400 lbs. nit. applied when plants in bloom	624	641	238	6	111	9	5
*E. 14.	400 lbs. acid phos., 100 lbs. sulph. am per a	591	609	231	13	96	9	13
*E. 19.	400 lbs. acid phos., 200 lbs. nit. soda and 200 lbs. sulph. am. per a	595	559	199	6	130	14	15

A full seeding, four kernels to the hill, means 648 plants to the plat. As most of the plats have a few vacancies, we must calculate our results in order to obtain comparisons to the full occupied plat. The following table represents the corrected yields expressed in bushels of merchantable corn per acre, 80 lbs. of ear-corn being estimated to yield a bushel of shelled grain.

CORRECTED PLATS.

		Merch. corn. yld. per acre: bus.
E. 10.	No fertilizer (no fert. 1884)	58.7
*E. 18.	“	56.5
*E. 6.	400 lbs. acid phos. per a	57.3
E. 9.	“ “ “ (no fert. 1884)	62.7
*E. 17.	“ “ “	56.4
F. 14.	“ “ “ (no fert. 1883, 1885, potash 1884)	65.8
F. 17.	“ “ “ (no fert. 1883, 1884)	51.1
F. 19.	“ “ “ (no fert. for 3 years preceding)	31.1
F. 21.	“ “ “ (no fert. 1883, 1885)	41.0
*E. 20.	800 lbs. acid phos. per a	45.0
*E. 7.	100 lbs nitrate soda per a	63.9
*E. 16.	200 “ “ “	50.0
E. 8.	100 lbs. sulph ammonia. per a. (no fert. 1884)	60.7
*E. 15.	200 “ “ “	63.2

*E. 11.	50 lbs. each nit. soda and sulph. am	65.1
*E. 12.	" " " " "	65.6
*E 13.	400 lbs. acid phos., 100 lbs. nit. soda per a	64.2
F. 13.	400 lbs. acid phos., 200 lbs. nit. soda per a., nit. applied when plants 1 ft. tall (1000 lbs. phos. 1884, no fert. 1883, 1885)	74.8
F. 15.	As F. 13, but nit. applied when plants in bloom (potash 1884, no fert. 1883, 1885)	61.9
*E. 14.	400 lbs. acid phos., 100 lbs. sulph. am. per a	63.6
*E. 19.	400 lbs. acid phos., 200 lbs. each nit. soda and sulph. am. per a	54.2

If we examine these figures closely, we find we cannot demonstrate any especial effect of the phosphate, and find that increased phosphate was followed by decrease of crop; that increase of nitrate of soda was detrimental, while increase of sulphate of ammonia was slightly beneficial, and that in general there is no relation between the crop and the amount of fertilizer used. The effect of previous fertilization seems to appear in F. 19 and 21, but can we be sure that the deficiency of crop arises from this cause? The following is the average of our figures, massing all minor differences of treatment:

	Merch. Corn: yield per acre.
No fertilizer applied	57.6 bushels.
Phosphate applied	51.3 "
Nitrate of soda	56.9 "
Sulphate of ammonia	61.9 "
Nitrate of soda and sulphate of ammonia	65.3 "
Phosphate, and nitrate of soda	67.0 "
Phosphate, and sulphate of ammonia	63.6 "
Phosphate, nitrate of soda and sulphate of ammonia	54.2 "

These figures do not certainly indicate decisive results. Yet we note with surprise that E. 6 and 17 show close duplication, as also do E. 11 and E. 12. If we arrange the results gained from the starred series alone, or the plats under duplicate fertilization heretofore, we have:

	Yield per acre.
No fertilizer	56.5 bushels.
400 lbs. acid phosphate per a	56.8 "
100 lbs. nitrate soda per a	63.9 "
100 lbs nitrate soda and sulphate of ammonia mixed	65.3 "
400 lbs. acid phosphate and 100 lbs. nitrate of soda	64.2 "
400 lbs. acid phosphate and 100 lbs. sulphate of ammonia	63.6 "

or an indication that on our soil phosphoric acid is in sufficient supply, and that nitrogen is the paramount constituent needed After determining this we may wisely ask what possible value does this conclusion possess for the farm next door, or to the farm in the next town, county or state.

WEEDS IN CORN.

In F. 11 we had a plat in which the weeds were allowed to grow undisturbed; in F. 12, a plat in which the weeds were pulled by hand, and upon which neither hoe nor cultivator was used. Each of these plats was fertilized at the rate of 400 lbs. of acid phosphate per acre, and planted with corn on May 19. The yields were:

		Merchantable.		Unmerchantable.	
	No. of plants.	Ears.	Weight.	Ears.	Weight.
F. 11	626	244	69–13	136	12–1
F. 12	609	690	265–5	208	19–2

We note that the neglected plat gave but few ears, which averaged 4.57 ozs. apiece, while the weeded plat gave ears that averaged 6.15 ozs. weight. E. 6 and 17, which may be considered comparison plats, and cultivated and hoed gave ears which averaged 6 ozs. weight.

Calculating these plats to the acre, and upon the basis of a full stand, we have:

		Yield per acre.
F. 11.	Weeds allowed to grow	18.1 bus.
F. 12.	Weeds hand pulled	70 5 “
E. 6 and 17.	Hoed and cultivated	56.8 “

If this experiment has a meaning, it is that cultivation is not beneficial to the corn plant, except so far as removing the weeds are concerned. Strangely enough, we have, during the existence of the station, been unable to obtain decisive evidence in favor of cultivation. Are then the opinions of all farmers as to the favorable effect of stirring the soil about the growing corn to be contradicted, or are we to conclude that plat experimentation is unreliable in its methods? I myself believe the latter. Here then is the dilemma, and has it more than these two horns?

FODDER CORN AS A FORAGE CROP.

In the D series of plats we have a number of trials for determining whether one race of maize furnishes a better forage plant than another. For this purpose the same quantity of seed and similar conditions of plantings were used.

In the first series about 20 kernels of corn per foot in the drill, and 44 inches between drills. The fertilization at the rate of 400 lbs. acid phosphate per acre, the planting May 12; size of plat 1-20 acre. The yield of green forage as cut:

	Plat number.	Yield per plat.	Yield per acre
Flint	(D. 1)	1119½ lbs.	11.195 tons
Dent	(D. 2)	1288½ “	12.885 “
Sweet	(D. 3)	999½ “	9.995 “
Pop	(D. 4)	1174 “	11.740 “
Mixture of above	(D. 5)	1508 “	15.080 “

In the second series, the conditions the same as in the first, except the drills were 30 inches apart. The yield of green forage was:

	Plat number.	Yield per plat.	Yield per acre.
Flint	(D. 6)	1905½ lbs.	19.055 tons.
Dent	(D. 7)	1821½ "	18.215 "
Sweet	(D. 8)	1306½ "	13.065 "
Pop	(D. 9)	1151½ "	11.515 "
Mixture of above	(D. 10)	1461 "	14.610 "
Mixture of abv., more seed	(D. 11)	1589 "	15.890 "

The varieties of corn used were Waushakum flint, Yankee dent, Stowell's Evergreen sweet, and Pearl pop, and these were selected as representing the kinds which by habit of growth seemed fitting for forage yield.

It will be observed that in both series of plantings the largest yields were from the mixed seed.

Also that the thicker planted series in general furnished the most forage.

Also that the various races did not hold the same relation of yield in the two series; thus in series one, the order of yield was Dent, Flint, Pop and Sweet; in series two the order of yield was Flint, Dent, Sweet and Pop. In comparative trials in 1884 the order was Pop, Dent, Flint and Sweet, and in 1885 the order was Flint, Sweet, Dent and Pop. The following represents the results of the trials as mentioned above, whereby the influence of season on forage crop is evidenced.

TONS OF GREEN FORAGE PER ACRE.

	1884.	1885.	1886**	1886.	Average.
Flint race	10.01	23.26	11.19	19.05	15.88
Dent race	10.57	18.13	12.88	18.21	14.95
Sweet race	7.95	20.33	9.99	13.06	12.83
Pop race	11.06*	16 20	11.74	11.51	12.63

*Double thickness of planting.
**Increased seeding.

The conclusion based on these figures must be favorable to the use of flint corn for forage purposes, and as shown in our fourth report (p. 36) must be favorable to close planting. The use of mixed seed is also indicated as of benefit.

FODDER CORN AND FERTILIZER.

In our trials with fertilizer, the Waushakum flint corn was the variety used, planted May 18, in drills 44 inches apart, and about 20 kernels to the foot of row. The results of the trial are given in the following table:

Plat number.	Fertilizer applied: lbs. per acre.	Yield of green forage: tons per acre.
D. 12.	200 lbs. acid phosphate	12.31
D. 13.	400 " " "	12.76
D. 14.	800 " " "	13.44
D. 15.	1600 " " "	12.55
D. 16.	200 " nitrate of soda	14.89
D. 17.	200 " sulphate of ammonia	15.56
D. 18.	No fertilizer	10.36
D. 19.	100 lbs. nitrate of soda, 100 lbs. sulphate of ammonia	14.37

It seems evident, therefore, that on our soil, in good condition, the acid phosphate was of advantage, but not proportionately to the quantity applied, and that nitrogen was a paramount constituent for the forage crop under these conditions.

We would note, however, that D. 1 and D. 12 are duplicate plats: their yields 11.19 and 12.76 tons per acre, difference 1.57 tons. We must therefore acknowledge that we are not justified in interpreting differences within one ton and a half, and hence cannot say that sulphate of ammonia is either better or worse for crop than the nitrate of soda, as in D. 16 and D. 17.

It is interesting to note in this connection that Alfalfa, as given in the Assistant's report, has yielded this year in its four cuttings a larger forage crop than any of our fodder corns.

POTATOES.

Owing to the drought in June, certain plats of early planted potatoes were such a complete failure as to destroy all their value for experimental purposes, and hence such are not reported upon. These plats were C. 1 to 8 inclusive. In all our experiments, the variety used was the White Star. The plats one-twentieth acre.

Plats C. 12 to 15 were planted with potatoes, single eyes, two of the plats with the seed placed in depressions, and two with the seed in hills, the rows 44 in. apart, the seed one foot apart in drill, the fertilization at the rate of 400 lbs. acid phosphate per acre.

		No. of plants.	Yield. Merchantable. lbs.	ozs.	Unmerchantable. lbs.	ozs.
C. 12.	Level culture	528	354	8	26	8
C. 14.	" "	542	395	8	35	0
C. 13.	Hill culture	543	490	0	46	8
C. 15.	" "	525	296	12	47	4

In this trial 1070 plants, level culture, yielded 750 lbs. merchantable and 61 lbs. 8 ozs. unmerchantable potatoes; 1068 plants, hill culture, yielded 786 lbs. 12 ozs. merchantable, and 93 lbs. 12 ozs. unmerchantable potatoes. The differences in yield are scarcely sufficient to justify a conclusion, being less than the differences between duplicate plats.

Plats E. 1 to 5, received fertilization at the rate of 400 lbs. acid phosphate per acre. Seed single eyes. The particulars of the trial are expressed below :

		No. of plants.	Yield. Merch. lbs.	ozs.	Unmerch. lbs.	ozs.
E. 1.	Rows 22 in. apart, plants thinned to one stalk per hill......	1078	314	7	40	4
E. 2.	Rows 22 in. apart, plants not thinned.	1110	141	0	35	14
E. 3.	Rows 44 in. apart, weeded and hoed ..	530	61	14	7	2
E. 4.	Rows 44 in. apart, neither weeded nor hoed	470	No crop			
E. 5.	Rows 44 in. apart, weeded not hoed...	522	165	8	21	12

In such an unfavorable season for early planted potatoes we must be cautious how we interpret our figures. These, however, seem to show that when too closely planted, as in E. 1 and 2, the removal of all the stalks but one from each hill was of great advantage.

E. 3 and 5 seem to indicate that cultivation was disadvantageous, and these in comparison with E. 4 seem to indicate that the object of cultivation for potatoes is the removal of weeds. A second trial, in another season, however, might destroy these conclusions and furnish new ones equally as reliable, for such is the disadvantage of the plat system of experimentation that we cannot be sure of the propriety of our conclusions for any one year.

In our F. plats, fertilized at the rate of 400 lbs. acid phosphate per acre, and planted at the ordinary distance, viz: drills 44 inches apart, hills one foot apart in drill. These plats were intended to illustrate the effect of the kind of seed used:

		No. of plants.	Yield: Merch. lbs.	ozs.	Unmerch. lbs.	ozs.
F. 2.	Ordinary whole potatoes..........	570	506	12	54	12
F. 5.	Small whole potatoes...	572	404	4	57	0
F. 6.	Large whole potatoes.............	580	467	12	78	4
F. 3.	Half potatoes, ordinary size.......	576	428	12	55	0
F. 4.	Quarter potatoes, ordinary size	567	393	12	42	8
F. 7.	Single eyes, ordinary size	563	321	8	41	8
F. 10.	" " " "	542	492	12	35	4

These figures, interpreted by the results of previous years trials, indicate that under circumstances of the distance of planting noted, and a fairly fertile soil, that large seed is advantageous, but that under certain as yet illy-defined conditions, as shown by F. 10, single eyes may be equally as productive.

In F. 8, single eyes were used, otherwise conditions as above noted. The same remark applies to F. 9. On F. 8, however, the tops were mowed on July 17, when about 9 inches tall. On F. 9, July 19, the tops were crushed down by running a hand roller over the field.

		Yield.			
	No. of plants.	Merch. lbs.	ozs.	Unmerch lbs.	ozs.
F. 8. Tops mown	543	129	4	26	8
F. 9. Tops rolled down	522	145	4	35	0
F. 7 and 10. Ordinary culture. Average	552	407	2	38	6

We must hence surmise that the removal of, and the injury to the foliage was detrimental.

In G. 6 and 7, a duplicate trial:

		Yield.			
	No. of plants.	Merch. lbs.	ozs.	Unmerch lbs.	ozs.
G. 6. Tops mowed	582	170	0	51	4
G. 7. " "	569	186	8	50	6
G. 8. Ordinary culture	583	370	8	112	0

In G. 4 and 5, we have similar plantings and fertilization as above, but the single eyes placed in the one case, the cut side down; in the other, the cut side up.

		Yield.			
	No. of plants.	Merch. lbs.	ozs.	Unmerch lbs.	ozs.
G. 4. Cut side down	589	60	12	81	8
G. 5. Cut side up	591	74	8	97	12

The effect of the drought is here so manifest in the reduced yield, as to make the comparison unreliable.

VITALITY OF SEEDS AS INFLUENCED BY AGE.

In the practical germination of seeds, a great difference is often to be observed in the vitality represented by sprouting, as between different samples, an aged lot occasionally germinating a far better precentage than a fresher sample. Thus two germinations of turnip seed seven years old gave 98 per cent. of growth, equaling the result to be expected from fresh seed; one sample nine years old gave 82 per cent. germination; one sample twelve years old gave 62 per cent., and yet in the larger number of cases, samples of the extreme ages noted, fail to respond to the stimulus of moisture and temperature. Vilmorin gives ten years as the limit for the vegetation of turnip seed. This variability between different samples of the same age, is induced in all probability by the union of several causes, among which may be prominently noted the character of the season when grown, and the method of harvesting and preparation. From the results of experiments noted in our last report, we may reason analogically from what was observed in some seed, that when seed was harvested, carefully and thoroughly dried to the utmost limit, and then stored in a dry place, that such seed will retain their germinative vitality for a much longer time than when such conditions have not existed, or have only existed in part.

On account of this variability as between samples, a true expression of germination results which shall generally hold true can only be effected through the merging of individual results into a general average, and the value of the figures gained will depend largely upon the number of separate trials, and the number of seed used. We have hence separated from our germination trials to date those which represent at least ten trials and one thousand seed or more, and offer these as provisional results applicable to commercial seed.

GERMINATIONS OF COMMERCIAL SEED.

	Years. Age.	No. of trials.	No. of seed.	Germinated. Per ct.
Beet	1	26	1900	71
	2	31	2750	71
Brocoli	2	12	1200	64
Brussels sprouts	1	13	1300	66
Cabbage	1	76	7150	86
	2	82	6400	75
	3	47	3800	62
	4	10	1000	54
Carrot	1	44	4400	86
	2	34	3400	34
	3	11	1100	20
Cauliflower	1	44	4400	86
	2	26	2600	84
	3	17	1700	61
	4	15	1500	54
Celery	1	13	1300	40
Cucumber	1	23	1122	84
Egg plant	1	18	1700	42
Kohl rabi	1	10	1000	80
Leek	1	16	1600	58
Lettuce	0	45	4500	80
	1	22	2200	84
	2	47	4700	79
	3	34	3400	83
	4	27	2700	71
	5	15	1500	65
	6	10	1000	29
Melon	1	26	1120	89
	4	36	1892	78

	Years.		Germinated.	
	Age.	No. of trials.	No. of seed.	Per ct.
Onions	0	14	1400	74
	1	252	21157	74
	2	123	12300	57
	3	31	3000	28
Parsley	1	26	2600	64
Pea	0	20	1232	87
	2	70	3844	87
Peppers	1	17	1700	62
	2	24	2150	54
Radish	1	143	12700	77
	2	42	3100	61
	3	18	1450	50
Ruta baga	0	28	2800	99
	2	90	5050	92
Savoy Cabbage	1	10	1000	92
	2	10	1000	86
Sorghum	2	18	1582	33
Spinage	0	16	1600	39
	1	14	1400	32
Tobacco	2	11	1100	35
	6	10	1000	61
	8	10	1000	54
Tomato	1	19	1400	85
	2	32	2250	86
	3	15	1400	88
	4	11	1100	79
	5	11	1100	81
	10	17	1200	84
Turnip	1	77	4100	88
	2	50	3500	94
	3	28	1900	94
	4	40	3150	85
	7	15	1400	47

AGE AT WHICH SEED MAY GERMINATE.

Under favorable conditions of harvesting and keeping, some varieties of vegetables may retain their germinative vitality through many years, and some seed, such as tomato seed, may be as useful at ten years of age as when younger. To illustrate the limit of age for influencing vitality, we select for certain varieties the highest figures of germination obtained in the case of seed several years old. For the material used in this study we are largely indebted to J. M. Thorburn & Co., seedsmen of New York city, whose reliability amply justifies our assumption of correctness in the ages as given, and who kindly forwarded to us seed in packages marked with the year of growth. We add in a parallel column the germination limit as given by Messrs. Vilmorin, in their Les Plantes Potageres, Paris, 1883.

Vegetable.	Age of sample. Years.	Largest per ct. of germ. obtained.	Vilmorin's table. Mean age.	Vilmorin's table. Ex. age.
Basil	9	17	8	10
Beet	15	24	6	10
Borage	9	4	8	10
Brocoli	11	4	—	—
Burnet	8	38	3	9
*Cabbage	17	1	5	10
Corn salad	10	2	5	10
Cress	7	65	5	9
Cucumber	13	40	10	10
	19	14		
Egg plant	10	55	6	10
Kale	7	60	5	10
Lavender	16	2	5	6
Leek	7	8	3	9
Lettuce	5	93	5	9
Mangold	9	66	6	10
Melon, musk	10	85	5	10
	14	56		
Melon, water	10	58	6	10
	11	16		
	12	20		
	13	13		
Mustard	10	8	4	10
	11	4		
Nasturtium, Tall	6	4	5	5
Onion	4	32	2	7
Parsley	4	30	3	9
Parsnip	3	26	2	4
Pea	3	94	3	8
Peppers	8	6	4	7
	9	36		
	10	2		
	13	1		
Radish	8	17	5	10
Rhubarb	4	84	3	8
Roquette	4	97	4	9
Rue	5	7	2	5
Ruta baga	14	50	5	10
Salsify	3	38	2	8
Savoy cabbage	8	24	5	10
Scorzonera	5	13	2	7
Sorghum	4	90	—	—
Sorrel	19	1	4	7
Squash	10	18	6	10
Tobacco	21	4	—	—
Tomato	10	96	4	9
	11	95		
	12	98		
	13	87		
	14	92		
	16	56		
Turnip	9	82	5	10
	12	62		

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*Cabbage germinations.

Age.	One lot. Per ct. germ. 1st trial.	One lot. Per ct. germ. 2d trial.	Another lot. Per ct. germ. 1st trial.	Another lot. Per ct. germ. 2d trial.	Third lot. Per ct. germ. 1st trial.	Third lot. Per ct. germ. 2d trl.
10 years	36	22	0	0	–	–
11 "	1	0	0	0	–	–
16 "	0	0	–	–	–	–
17 "	1	1	1	0	0	0

BOTANICAL NOTES.

We have had, this year, a most excellent illustration of the apparent influence of a cross between two quite divergent races in stimulating atavism.

Last year the Bruine geel lettuce (Red Edged Victoria, No. 49, Report of 1885) was crossed with pollen of the Deer Tongue (No. 69, Report of 1885), and the resulting seed was reserved for planting in 1886.

In 1886 the crop from this seed showed very divergent characters, and all could be referred to types of varieties embracing seven distinct sorts.

One, the Curled Cutting (No. 86, Report of 1885). As the Curled Cutting lettuce occupied an adjoining row, there was a possibility that the seed appeared in the crossed row through accident.

Another kind was of the Deer Tongue type (No. 69, Report of 1885), but the leaves somewhat broader, little less erect, less glaucous, and more deeply dentate in the lower half. This plant can be identified with the Lattuga franzese, figured by Castor Durante in his Herbario novo, 1617, page 244; while another plant seems nearer to the Lactuca folio oblongo acuto, figured by Caspar Bauhin in his Prodromus, edition of 1671, page 60. These two figures seem to be the Lactuca longifolia described by Bauhin in his phytopinax, 1596, page 200.

The third kind was The Deacon (No. 56, Report of 1885). This lettuce was grown three rows distant, and there is a possibility of the seed having blown in at the time of planting.

The fourth kind may be referred to as the Cos type. In this case there can be no uncertainty in regard to type, but we are unable to refer precisely to a distinct variety. The leaves are obscurely pointed, are larger than those of other varieties, excepting the Monstrous Brown or the Florence Cos., have considerable lustre, and are somewhat blistered; the rib quite spiny in the lower portion. The resemblance to Lactuca intybacea, Gerarde's Herbal, 1597, is quite noteworthy.

The next plant resembles the last, but the leaves are narrower and less blistered. The third plant of this type has broader leaves, with a somewhat ruffled margin, and is more obscurely pointed.

The sixth sort is a spotted Cos., the leaves having scattered chocolate-colored spots.

The seventh plant answers to the description of Lactuca silvestre, as given by De Candolle in his Flore Francais, and of which he gives as synonyms Lactuca scariola Lin, and Lactuca sylvestris, of Camerarius' Epitome. By referring to this latter, edition of 1586, page 300, our plant is found figured.

The results of this trial are that we have seven distinct varieties of lettuce, all originating from seed from the same plant. While in the case of the Curled Cutting and the Deacon there is a possibility of the seed having been blown in from adjoining rows, yet in view of the care exercised, and that these plants all occupied their proper position in the row, and as it is not more surprising to assume that these known varieties would appear than it is to observe the appearance of the unknown to us Lactuca sylvestre, I think we may assume that their appearance represents a true conclusion, and that is that the influence of the cross was to produce both a near and a remote atavism ; and we may reasonably conclude that the unnamed forms represent forms which might receive identification were we well enough acquainted with varieties which have been and are now grown.

Similar notes have been taken with what may be supposed to have been a crossed melon. In 1885 a Hackensack melon, to all appearances, and of most excellent quality, was produced from the seed of the Christiana melon. This year the seed from this Hackensack melon produced nearly its full crop of a fruit which may be the true White Japan. There is, however, one fruit of the Hackensack form, and there are two that resemble the Christiana. The melon of the Hackensack type, however, has salmon flesh instead of the paler green flesh of the true variety, while those of the White Japan have the pale green flesh which belongs to that variety.

CABBAGE.

In 1821, M. Augustin Pyramus De Candolle read before the Horticultural Society of London a memoir on the different Species, Races, and Varieties of the Genus Brassica, in which he adopted a classification which is sufficiently detailed to serve in a large measure the purposes of an agricultural classification, especially for the heading class. His classification of the species is as below:

SPECIES. BRASSICA OLERACEA.

First Race.—Brassica oleracea sylvestris. Wild Cabbage.
Second Race.—Brassica oleracea acephala. Tall or Open Cabbage.
Third Race.—Brassica oleracea bullata. Blistered Cabbage.
Fourth Race.—Brassica oleracea capitata. Round-headed Cabbage.
Fifth Race.—Brassica oleracea caulo-rapa. Turnip Cabbage.
Sixth Race.—Brassica oleracea botrytis. Flowering Cabbage.

The second race corresponds to our Kales, the third to our Savoys, the fourth to the Cabbage proper, the fifth to the Kohl-rabi, the sixth to our Brocolis and Cauliflowers.

The fourth race, Brassica oleracea capitata, presents, according to De Candolle, variations which are chiefly confined to the shape of the head and the color of the leaves, and as the first circumstance appears to our author as the most important, he has adopted the shape as the characteristic of the varieties and admits as sub-varieties the green, and the purple or red colors. His varieties are :

1. Depressa. The Flat-headed Cabbage.
2. Sphærica. The Round-headed Cabbage.
3. Obovata. The Egg-shaped Cabbage.
4. Elliptica. The Elliptic Cabbage.
5. Conica. The Conical Cabbage.

His illustrative sub-varieties are for 1, *Chou de Strasburg;* for 2, *Chou cabus commun ;* for 3, no common name ; for 4 *Chou d'York ;* for 5, *Chou en pain de sucre*, etc.

De Candolle appears to have overlooked the significance of the occurrence of parallelisms in the variations that occur within the different races ; is evidently at fault with the Portugal cabbage, and the Pak Choi and the Pe Tsai had not at that time come under his observation. In the light of additional information to that which he possessed, we must recognize the necessity in the fullness of time of a new classification which shall present characters more generalized as well as more specialized, and in harmony with the history of origins and developments.

At the present writing I propose to examine the history of the heading cabbage in certain of its aspects, and for this purpose I shall adopt DeCandolle's division, Brassica oleracea capitata, varieties 1 to 5, although in great doubt as to the botanical correctness of the inferences suggested by the name and treatment. In regard to one point, however, we may be reasonably assurred. No new types of the headed cabbage have appeared in quite recent times, and all the types, which DeCandolle classifies as varieties, have a more or less remote origin.

The cabbage was in esteem in the ancient world, and a number of sorts are named by the Roman and Greek writers, but it seems the merest guess work to attempt to identify with varieties now grown. At the most, we can believe that they had the headed cabbage, and the Savoy, along with coleworts, and very likely others. To quote from the numerous commentators of the sixteenth and seventeenth centuries would be merely an affectation of learning, without adding any certainty to our conclusions.

1. Brassica oleracea capitata depressa, DC., the Flat-headed Cabbage. This form has received the modern name of Drumhead, and I find it figured in Pancorius Hubaruni,

1673, No. 612, under the name Brassica Capitata, Kopffkohe. It may be the Brassica alba sessilis glomerosa, aut capitata Lactucae habitu of Pena & Lobel, Ad. 1570, 91, and an esteemed vegetable in Italy and France, but this reference must be considered only as a supposition until supporting evidence is adduced. Lobel's figum, Stirpium Nistori, 1576, referring to the Adversaria, p. 91 is a round cabbage. The Chou Fumel of Vilmorin answers fully the description in the Adversaria, so far as it goes, and the picture in Vilmorin's Album, No. 47378, might well be mistaken for a lettuce. Wheeler, 1763, and Mawe, 1778, speak of a flat-topped cabbage, as does Lamarck in 1783, and Drumheads are named by M'Mahon in 1806. The prevalence of the word Dutch, Strasburg, d'Allemagne, Brunswick, etc., as applied to varieties of this form, would indicate Germany or Holland as a source of distribution or origin.

2. Brassica oleracea capitata sphaerica, DC., the Round-headed cabbage is the type figured in all the herbals to which I have had access, as follows:

Fuchsius, 1542, p. 416. *Ger.* Kappiskraut.
Tragus, 1552, p. 717. *Ger.* Kappes.
Matthiolus comm, 1558 247. Brassica capitata.
Pinaeus, 1560, 163. *It.* Cavolo Cappuccio. *Ger.* Capshaut. *Fr.* Choux Cabuz.
Lobel, 1576, 123. Brassica Capitata. *It.* Cavolo Cappuccio, Capuzzine.
Pictorius ed. of Aem. Macer 1581, 90 (Same picture in ed. of 1559). *Ger.* Kabiskraut.
Camerarius epit. 1586, 250. *It.* Cavolo cappuccia. *Ger.* Kapskraut. *Fr.* Choux Cabuz. *Span.* Repolho, Colhes morcianos.
Gerarde. 1597, 245. Red Cabbage Cole, White Cabbage Cole.
Dodonaeus pempt. 1616, 621, 623. *Ger.* Kappiskraut. *Bel.* Cabuys koole, Sluytkoole. *Fr.* Choux Cabuz. *Sp.* Repolho, Colhes morcianos. *It.* Caulo Cappuccio, Cappuzzias. *Eng.* Cabbage.
Bodaeus ed. of Theophr. 1644, 777. Brassica capitata alba.
Chahaeus. Stirpium Sciaqraphia et Icones, 1677, 269. Brassica capitata alba.

3. Brassicia oleracea capitata obovata, DC. The Egg shaped cabbage, the small end of the oval being downward.

4. Brassica oleracea capitata elliptica, DC. The Elliptic cabbage, the head a perfect oval, swelling out in the middle. The type of this, the Early York, is said by Rogers, quoted by Burr, to have been brought from Flanders to England by a soldier, more than a hundred years ago; as Burr wrote in 1863, this would place its introduction antedating 1763. It is mentioned by Stevenson, 1765, without any indication of its being other than a well-known variety. I do not find it figured by any of the earlier writers, nor do I recognize it in any of the synonyms of Bauhin. Perhaps the long-sided Cabbage of Quintyne, ed. of 1693, belongs here, but I

find no suggestion of mention in Le Jardinier Solitaire, 1612, nor in Laurembergius, 1631, two works on gardening quite complete for their time.

5. Brassica oleracea capitata conica, DC. The Conical Cabbage, the shape that of a long egg, the large end downwards. The types of varieties named are the Chou Chicon, Chou d'Aubervilliers, the Chou de Battersea, the Chou a tete conique, and the Chou pain de sucre. The Sugar loaf Cabbage is mentioned by Townsend, 1726, Wheeler, 1763, Mawe, 1778, etc; and the Battersea by Townsend, 1726, and Stevenson, 1765.

We may infer from this review that all our types of cabbage existed in the last century, and furthermore that the Round-headed form is not only the oldest form in culture, but that it was the form most generally grown in the sixteenth and seventeenth centuries. Quintyne, who was the gardener royal in France, published his first work in 1690, which was translated into English in 1693, scarcely mentions the Cabbage, but gives some prominence to the cauliflower, and most of all to lettuce. He evidently did not grow for the royal table aught but the common kind, which was doubtless the round and the long sided. We may assume, therefore, that the other sorts had not received distribution to France much preceding the eighteenth century.

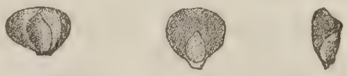
INDIAN CORN.

Through the kindness of Dr. Edward Palmer of the Smithsonian Institution, I received in 1885 nine ears of corn collected from the Cocopa Indians, Sonora, and in 1886 fifteen ears collected from the Tarahumarer Indians, Mexico, and seventeen ears collected at the Indian village of San Padro, Mexico. In 1884 I received six samples of the corn grown by the Zuni Indians, from Mr. F. H. Cushing, and previously samples of Mandan corn said to be originally from the region of the Upper Missouri; the Wyandotte, said to have been formerly grown by the Indians of Illinois; the Tuscarora; samples from Manitoba; and Canada corn, traditionally carried back to Indian origin, as the Blue corn. In addition, for comparison, I have collected hundreds of named samples from various parts of the United States and Canada, those sold as seed-corn in France, and from Messrs. Landreth & Sons, of Philadelphia, samples procured from Africa, and have examined ears by the thousand from crops grown from several hundred different seedings. From these sources I derive the conclusions that it is the object of this paper to state.

The necessities of Agricultural Botany require a nomenclature, whereby distinct forms can be readily distinguished, for in accurate study we must be able to express briefly differences which are constant and in a measure specific. I have therefore adopted the binomal system, and have used a * between the generic and specific name to indicate that the nomenclature refers to agricultural relations and does not take account of received botanical species, except by inference.

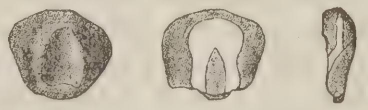
Zea Mays, L. presents a number of agricultural species which can be readily identified, and with one exception, present characters which do not overlap, and which cannot be mistaken. This exception is the separation of the Pop corns from the Flint corns, which for agricultural purposes must be kept distinct, and yet at times trespass over border lines which we establish. These agricultural or * species are founded upon the character of the ripe kernel, and are:

Zea * everta. The Pop Corns. The kernel split laterally shows two distinct structures : the chit and the corneous matter enveloping. In some cases a fine white starchy line can be detected, and in other cases the appearance is of a flint, and the diminished size must aid in the separation, as also the property of "popping."



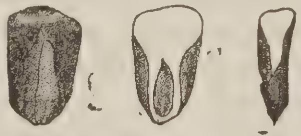
NEW ENGLAND POP.

Zea * indurata. The Flint Corns. In this class the split kernel shows three structures. the chit, starchy matter, and a corneous matter enveloping.



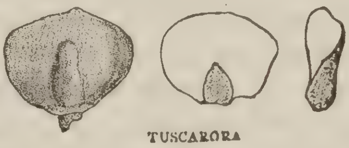
CANADA.

Zea * indentata. The Dent Corns. Here we have visible in the split kernel, the chit, corneous matter on the two sides, and starchy matter extending to the summit.



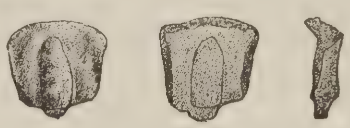
QUEEN OF THE PRAIRIE.

Zea * amylacea. The Soft Corns. The split kernel shows but two structures, the chit and starchy matter which occupies the remaining space within the pellicle.

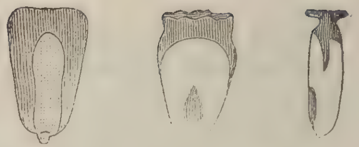


TUSCARORA

Zea * saccharata. The Sweet Corns. This class is at once known by the translucent horny appearance, more or less crinkled or wrinkled, and by the split kernel showing only the chit and corneous matter, no starchy matter being in general visible, although occasionally in single kernels a fine line may be detected.



ASYLUM.



Zea * amyleasaccharata. The Starchy Sweet Corns. This * species is founded upon three varieties found in the San Padro village collection. The external appearance is that of the Zea * saccharata, but the horny matter in our specimens more translucent. Its distinguishing character, however, is in the internal arrangement of the kernel, the lower portion being starchy, the upper horny and translucent.

Within these * species, certain variations pursue a parallel course, and these we at present distinguish under letters of the alphabet, as below, and term Races:

A. Kernel broader than deep.
B. Kernel as broad as deep.
C. Kernel much deeper than broad.

In general, but with some exceptions, the corns of Race A have in the main a cylindrical cob, and a medium stalk, the kernels not rounding over but, and well marked tendency to swell at the but through added kernels or rows. They are usually 8-rowed. Here, however, we must provisionally class certain corns with small ear stalk, and fusiform ear.

In Race B we have in the main a slightly tapering cob, a large ear stalk, a tendency to swell at the but through added kernels or rows, the kernels not rounding over the but, usually 12-rowed varieties. We must provisionally class here, also, a few fusiform shaped cobs with small ear stalks.

In Race C we find usually a small, often very small earstalk, a strongly tapering or fusiform or cone-form ear, kernels rounding over the but, and the varieties many rowed.

With a less material for study, these races would show a well marked separation, as illustrated in my classificatory attempt of 1884, founded upon shape of ear; but these later collections of Mexican Indian products indicate that the form of the kernel has a double set of corelations with the cob and the ear.

A second group of uniformities with parallel occurrence within the Races, and the starred species may be called Tribes, the distinction being founded upon the shape of the ear, as follows:

Tribe I. The ear cylindrical, or mainly so, from but.
II. The ear tapering, from but.
III. The ear tapering both ways from a point below the but, oval or fusiform or cone form; often the appearance expressed by the description as rounding over the but.

The minor features of classification, below tribes and above varieties are color of kernels and cob, the shape of the kernels as expressed by their effects in forming sulci or otherwise between the rows, a scalloped or flat appearance to the circumference of the ear in section, etc.

The variety characteristics are size of ear, more particular description of form, number of rows, more particular descriptions of shape and color of kernel, etc.

So far as my collections allow of generalization, Tribe I is a northern form, or a form of cool regions, as it is of most general occurrence in the northern limit, or the more elevated limit of the agricultural species. Tribe II is an intermediate climate, or temperate form, while Tribe III occurs oftenest in the regions of hot and long summers.

In the Races likewise the same fact seems established: Race A being largely northern, Race B mostly temperate, and Race C being more tropical. Whatever exceptions may appears to this generalization can be usually satisfactorily explained by the study of the local conditions which appear from the history of the sample.

In the generalizations concerning the Agricultural Species, as founded upon our collections and historical records, we must call Zea * indurata, or flints, the most northern, although probably had circumstances justified the growing, Zea * everta, the pops, could occupy this position. The first * species has been received from Quebec, our highest northing, and was the kind almost or probably altogether exclusively grown by the New England Indians, although probably grown also by the Indians of the midland and more southern coast regions, as also in places in the Middle States, and further south, extending to South America. The historical references for this statement are rather obscure, but the Indian derived words, Samp and Hominy, indicate flint corn, and flint corns are now found which traditionally have come from the Indians, or are at present grown by the Indians, as by the Tarahuamarers of Mexico in our collections. It may be obscurely identified in the early writers on Peru and Paraguay, and in the figures of the botanists of the sixteenth and seventeenth centuries.

Zea * indentata, the dents, has a few forms which can be described as northern temperate, the furtherest point northward represented in my collections being Ogdensburg, N. Y., where the climate is modified by the geographical surroundings. As a rule, however, this * species cannot be grown successfully in New York, except in favored localities. In the Middle West it is the predominant form, and furnishes the larger portion of our corn for export. It is now cultivated by the Indians of Northern Mexico, as shown by our collections, and probably was known to the early colonists throughout our southern country, although no certain identification can be made from early writers.

Zea * amylacea, the Soft, has an extended range. A northern form has come to me from Manitoba; we cannot question that it is the Tuscarora formerly grown by the Tuscarora Indians of Carolina and afterwards grown by them in New York; the Wyandotte corn of the Illinois Indians; the Squaw corn of the Mandans; the Omaha corn of Missouri; and in many varieties the leading corn of the Cocopa Indians, the Zunis, and the Indians of Northern Mexico, and also those of the region of the Parani river in Brazil. It furnished some at least of the "Mummy" corn of Peru, and was probably the *Capia* of de Vega. It does not seem to have ever reached the New England Indians, and we find no colonial or precolonial mention of this form in the Middle States. It is but rarely grown in American agriculture. The use of the word *pone* in the Southern States may indicate this corn, as it seems to be best liked where primitive milling conveniences are in vogue.

Zea * saccharata, the Sweet, is such a strongly characterized * species, that it seems strange that its peculiarities could have escaped the notice of the colonists. The only early records we have been able to find certify that it was brought from the Indian country in the region of the Susquehanna, in the last century. It is now universally grown in gardens, and its use as a green vegetable admits of its being successfully grown beyond the northern limit in which it can ripen its seed, as with modern intercourse seed can always be cheaply obtained, and there need be no dependence on home supply.

Zea * amyleasaccharata, the Starch sugar, is a peculiar species thus far only received from the Indian village of San Padro, Mexico. The perfection of the ears, and the absence of cross-fertilization in the kernels, and three varieties which are quite distinct in their characters, indicate a long and careful cultivation.

In the examination of collections of corn from very diverse localities, one of the most striking reflections must be the permanency even in variety characters that is exhibited. The King Philip corn, taken from an island in New Hampshire in 1847, and extensively distributed through the agricultural department of our government during succeeding years, is at present continually appearing in our collections from all portions of the Northern United States, apparently unchanged by its thirty or more years of culture in different climates and by different farmers. The figures of varieties sold in our seed catalogues of 1869 answer for the same varieties to-day. In view of these facts, it may be proper to offer the results of experimental experience upon the permanency of varieties.

Varieties of the same general character cross-breed very readily, and this also seems to be the case as between varieties of the same tribe within a race, and between varieties occupying like positions of classification in different races. Purity of seed, however, may offer a prepotency which shall reject outcrosses, so long as the variety pollen is present in sufficient abundance. One illustration of this proposition may be allowed. The Waushakum Flint Corn is a pure bred variety of marked uniformity. This variety in 1882 was grown alongside ten other varieties; the resultant seed was planted in 1883 amid 128 other sorts; the resultant seed in 1884 was again planted amidst 135 other sorts. In 1885 the crop was perfectly on type, and neither in this year nor in the preceding years were any effects of cross-fertilization apparent.

The mass of the evidence gained by experimental trials, justifies the proposition that there is a resistance to cross-fertilization as between the tribes. Repeated plantings of the tribes I, II, and III together have given no cross-breds, and no variations, with but a few obscure exceptions. These exceptions probably came from the exclusion of its own pollen, whereby a forced cross was admitted. This matter will be referred to later on in treating of * species crosses.

A like resistance to crosses has also been observed as between the races. Corn of the different races grown together have not given from their planted resultant crop, any evidence that can lead to any other inference save that in the presence of their own pollen, other race pollen has been rejected.

In respect to the * species, we find that from current hybridization, one species can pass to another, but not uniformly in both directions. Thus the flint kernel may appear on the sweet ear, but the sweet kernel does not readily pass to the flint; but in all these cases the crossing only takes place between like races of the two species. We have observed few, if any indisputable instances of the flint and dent, or sweet and dent kernels appearing together on the same ear from plants of our own growing, but a few cases of such crossings have been noted in collected ears, of whose history we have no knowledge. The seed planted from currently hybridized samples, show that hybridization has taken place between the * species, for the crop is not uniformly of a kind. The tendency is, however, very strongly towards the production of the parentage, without intermediates; so much so that it is doubtful if intermediates are often produced. Thus African seed has varied only towards varieties of the African type; French seed has varied only towards French varieties; Station seed has produced crop which could in nearly every case be identified with varieties with which crossings might have been effected; seed from distant regions of our country vary towards the types grown in those regions whence they came.

Repeated crossings, however, seem to destroy this tendency towards a close reproduction of the parentage. Thus the crop from hybridized seed planted in turn is subject to the uniform variations noted; the crop again planted is subjected to a still further variation, and when by this means the variety character is weakened, we may note occasional exceptions in succeeding crops from the course we have already outlined, and sweet and dent, dent and sweet, sweet and flint, and flint and sweet, or flint and dent, and dent and flint kernels may sometimes appear on the same ears, thus creating an impression that variety characters cannot be preserved in cases when two or more kinds of corn are grown together. Such occurrences are, however, very rare with us, but sufficiently indicated to warrant the belief that the explanation is a reasonable one. Some of the instances can be explained by the hypothesis that the variety pollen failed, and a force cross then took place.

A few examples, selected on account of their absolute character, may be given.

In 1882, a plat of Waushakum Flint was grown alongside a Minnesota Dent. The seed of either planted in 1883 yielded partly Waushakum Flint ears and partly Minnesota Dent ears, with no intermediates. This trial is noteworthy as being on a large scale.

The Rural Thoroughbred Dent, grown at the Station 1884, yielded in 1885 perfect samples of the Rhode Island White Cap Flint, some Benton Dent, and some ears on type of variety planted; the Rhode Island White Cap, of like history, and which had pollenated the Rural, yielded in its turn all its ears on type.

Our Husk corn received in 1882 was all of the dent * species, and was allowed to hybridize in 1882, 1883 and 1884, so that the crop of 1885 might be expected to be extremely variable, as the variety characters must have been greatly weakened. In 1885 some dent or soft kernels (which could not be told except by destroying the seed) from a podded sweet ear were planted. The crop was five pod, and fourteen unpodded ears. The pod ears resembled in form the pod ears of 1883; twelve unpodded ears were precisely the unpodded ears of 1883, and two ears were the Zuni Yellow soft corn, with pink kernels instead of yellow.

One peculiar characteristic of the crossed corns, a characteristic which I am unable at present to prove, but yet I believe our general experience warrants the statement, is the tendency of a cross-bred to purge itself of its cross, and to gradually become nearly thoroughbred. I gather this conclusion from the gradual reduction of certain forms, and the increase of the predominant form in mixed crops grown successively from the mixed seed of two or more varieties. It is only from this tendency that under the, in general, careless conditions of cultivation, varieties of corn can retain their variety characteristics, under so many diverse conditions of climate, soil and culture.

In these observations one peculiarity may be emphasized. The resistance to crossings as between the races and tribes seems as great as between the * species; a result entirely unexpected. Yet the transference of color through current hybridization, without a transference of corresponding variability in the planted seed, seems to offer at times paradoxical results. In some rather rare cases, the characteristics of two * species occur in the same kernel, but the lines of demarcation are then very distinct, there being no blending.

The object of the present paper is to show that there is a sufficient characterization and permanency to an agricultural species to warrant attempt at nomenclature, and to offer inducement to others in recognizing that agricultural divisions may be founded upon data easy of perception, to be more specific in their writings, in order that by the accumulation of carefully chosen material, agricultural science may be furthered. Much more study and larger and more widely collected collections must, however, be made before our classification can be considered final.

In the report of 1884, I published a classification of corn based upon my then collections and gave illustrations of the varieties. While it is deplorable to have to change one's views as radically as this present offering shows, yet it is yet more deplorable to think that enlarged collections may in time overset the present classification. In agriculture we have none of those complete collections which are at the service of the botanist in the form of herbaria and illustrated plates, and hence success can only be secured by a series of attempts which in their failures shall stimulate correctness. It is from this view that I delay at present to re-arrange our formerly described varieties under the present classification, and withhold the description of new varieties which have since come to hand.

TESTING OF VARIETIES.

The value of variety tests must consist in a study of the plant habit. To merely record that one variety is more or less prolific, or is better or worse suited for general culture, is not sufficient, and when such recommendation is founded upon yield alone, may be and probably is misleading. Director A. reports that one oat is more prolific than another, and so also do Directors B. and C. The same variety is rarely agreed upon, and the opinions, for we can call these expressions of results by no other name, are usually contradictory. An examination of the preceding reports of this Station will evidence that the relative order of maturity or of prolificacy do not hold through successive years. The true study of variety, to be of value, must embrace the properties of the plant whereby certain adaptations are attained which render the variety better fitted for certain conditions of culture. Thus we would know of grain, whether stiffness of straw or weakness of straw, whether ability to endure high cultivation, or thin seeding or hardiness, etc., are an inherent property of the variety. We would know whether some varieties are more resistant to drought than others, or can withstand wetness. We would know the relations of the plant toward conditions apt to occur in cultivation, and the better we know these, the more reliable become the conclusions which are derived and disseminated as an aid to the cultivator. It is one of the necessities of true experimental work that complete conclusions are not at once to be attained, and hence a certain incompleteness must appear in the reports, and the value of our work must largely depend upon the intelligence of the farmer who studies our results in order to find a few adaptations which seem fitted to his own use and which correspond to his own experiences. For us to say at the present stage of agricultural study that one variety is best, and inferentially that such variety should be adopted by all, would savor of quackery. The best reports we can offer are the results of trial under conditions as noted, and memoranda of variety peculiarities, or such of them that we are able to definitely record.

Report of the First Assistant.*

INTRODUCTION.

The following report is the result of such work as I have been enabled to perform, in addition to my regular Station duties as First Assistant. This work has been confined to the special study of cereal varieties, and the conducting of such experiments as time and means would permit, relative to wheat, oats, barley and rye.

No work has yet been attempted in America, so far as is known, in the way of carefully studying from living specimens, the cereal varieties, resolving them into their various classes, reducing to synonyms, and clearing away in a measure the mist which surrounds them. The value of this work may perhaps be appreciated if the reader will remember that in the desire to secure money and speculate in new varieties, not only many seedsmen, but the honest farmers are yearly imposed upon by introducers of old varieties under new names, and at widely different prices. It has been my aim to carefully and conscientiously study each and every so-called variety, place all synonyms in their proper places, and describe the varieties as clearly as possible. It is true that these descriptions are not perfect, and that they do not cover the whole field necessary to enable us to always determine varieties, simply by its aid, but they are presented in concise form, as the result of much valuable data, in the hope that they will be of value to those who may have a use for such material. In every case, in addition to the mere note taking, a vast number of measurements were made, very many on each variety, of the various parts of the plant. These have a considerable comparative value, and are placed so as to be easily referred to.

WHEAT VARIETIES.

During the season of 1886, the study of varieties of wheat received careful attention in continuance of the work begun in 1885. The number of varieties was very considerably increased, and the notes taken covered the line of work more extensively. Increasing familiarity with the wheats, and a knowledge of the susceptibility to change in this cereal, has demonstrated the wisdom of not attempting to classify and place within too restricted lines, varieties possessing characteristics, the permanency of which are entirely subject to change of climate, soil or treatment. For this reason the classification presented is of the simplest kind, for purposes of convenience, the varieties closely allied being grouped together in classes, these latter being separated by lines of pronounced differences. By special culture and manipulation, man may produce radical changes of form and growth in both the vegetable and animal kingdom, and this holds true in the cereals as well as in other cases, but the classification given is intended to apply to varieties that have received such treatment as would not tend to throw them from the grooves within which their special characteristics are situated.

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*C. S. Plumb.

The classification adopted first resolves the varieties under the different sub-species of *Triticum vulgare.* These sub-species, when possible, are divided into two classes of bearded and beardless, and these sub-divided according to the color of the panicle.

In order to accommodate a large number of varieties in the field, so that they may present the best advantages for observation and handling, it is necessary to plant in rows far enough apart for passage between, and with individual plants widely enough separated in the row to avoid crowding. Grown in this manner, certain physical differences are to be noted. The plants are shorter; the panicles and seeds usually larger, and longer; the spikelets more widely separated, and the leaves of greater size than in ordinary field culture. But in view of the fact that the varieties described have all been grown on the Station grounds, under conditions as nearly equivalent as it was possible to secure, this difference is of no special importance, considering that it holds relatively the same with all the varieties.

The source from which the seed of the different varieties tested was received is noted after the name, in abbreviation, the key to which is as follows, to all of which parties we wish to express our thanks for favors received: O. H. Alexander, Charlotte, Vt., Alex.; A. E. Blount, Fort Collins, Col., Blount; John Bradley, Lyons, N. Y., Brad.; Country Gentleman, Albany, N. Y., C. G.; R. G. Crist, New Market, Ind., Crist; U. S. Department of Agriculture, Washington, D. C., Dept. Ag'l.; W. L. Eastman, Ovid, N. Y., East.; F. M. Etting, Concordville, Pa., Ett.; J. A. Everitt, Watsontown, Pa., Ever.; D. M. Ferry, Detroit, Mich., Ferry; J. J. H. Gregory, Marblehead, Mass., Greg.; H. M. Jaques, Wright's Corners, N. Y., Jaq.; Johnson & Stokes, Phil., Pa., J. & S.; D. Landreth & Sons, Phil., Pa., Land.; Jas. Miller, Penn Yan, N. Y., Mill.; Mr. Moffatt, Gorham, N. Y., Moff.; Ohio Experiment Station, Columbus, Ohio, O. E. S.; Patterson Bros., Windfall, Ind., Pat. Bro.; Pringle & Horsford, Charlotte, Vt., P. & H.; Rural New Yorker, New York city, R. N.-Y.; W. F. Seaving, Sherwood, N. Y., Seav.; Hiram Sibley & Co., Rochester, N. Y., Sib.; D. W. Sprague, Portland, Dak., Sprag.; J. M. Thorburn & Co., New York city, Thorb.; Vilmorin, Andrieux & Cie, Paris, France, Vil.

Synonyms are italicized. The averages given refer to the numbers or measurements most common relating to the part. The signs—, ‡, or + indicate whether the measurements tend to less, more or less, or slightly more than the figures given, — being minus sign, ‡ plus or minus, + plus. In order that the terms given may be understood by all, the following are explained: Culm: the stem bearing the head, or botanically speaking, panicle. The panicle consists of many breasts or spikelets, and the outer chaff of these is termed the glume, the inner enclosing the grain the flowering glume. The term glabrous signifies smooth, and glaucous, covered with a bluish bloom. Properly speaking, there is no red wheat, the color varying from yellowish-white through the various shades of amber, from very light to dark.

Some changes have been made in the classification presented in the report of 1885. The effort has been made to concentrate the varieties as much as possible, and when circumstances would permit, this has been done. In one or two instances, radical changes have been made. Another season's study has shown that Surprise and Washington Glass might with justice be considered different varieties. What were classed in some cases as varieties in 1885, have this year been placed under the list of synonyms. The period of ripening has not been considered an essential point in describing, as this is much subject to climatic and other influences.

Varieties of the following species of *Triticum vulgare* are described: *Triticum sativum; T. durum; T. polonicum; T. spelta; T. amyleum; T. monococcum.* None of these, in reality sub-species, excepting *sativum*, are commonly grown in America. They are mostly grown in Continental Europe, Asia and Africa.

TRITICUM SATIVUM LAM.

This species is composed of our ordinary or soft wheats. The stems are hollow, the grain soft; there are both winter and spring varieties, bearded and beardless. The varieties of this class are more extensively cultivated than any of the others. It is the common market wheat.

BEARDED WHEATS.

† Panicle Bronze.

I. DIEHL-MEDITERRANEAN, R. N. Y.

Synonyms: *Mediterranean Hybrid*, O. E. S.; *Michigan Bronze*, O. E. S.

Spring growth vigorous, erect, foliage profuse: Straw yellowish-white. Culms stout, of medium size, usually erect: Panicles long bearded, bronze, glabrous, square, very compact, crowded at the tip, and abruptly pointed: Grain large, plump, fairly long, medium light amber: Thrashes from glume very well.

Culm: average height 3 feet 6 inches; diameter 1-8 to 1-5 inch, average 1-5.

Leaves per culm 4; length from 3 to 10 3-4 inches, average 7; width of upper leaf 3-8 to 3-4 inch, average 1-2; lower 3-16 to 3-8, average 1-4.

Panicle: average length 2 1-2 ‡ inches; thickness has an average variation from 3-8 inch at base to 5 8 near the tip; breadth 5-8 to 3-4 inch.

Spikelets per panicle 17 to 19, average 17; 2 to 5 seeded, average 3; one thousand seeds weigh 602 grains.

2. IMPORTED MEDITERRANEAN, O. E. S.

Spring growth very weak and pale green in color: Straw whitish-yellow: Culms weak and usually recline upon the ground: Panicles long bearded, light bronze, glabrous, nearly square, loose, slightly tapering: grain very dark amber, large, long, shrunken: Thrashes from glume very well.

Culm: average height 3 feet 3 inches; diameter 1-8 to 1-5 inch, average 3-16.

Leaves: per culm 4; length 5 3-4 to 12 1-2 inches, average 8; width of upper leaf 3-8 to 15-16 inch, average 5-8; lower, 3-16 to 1-4 inch, average 1-4.

Panicle: average length 2 3-4 ‡ inches; thickness average 3-8 inch; breadth 1-2 to 5-8 inch, average 1-2; spikelets per panicle 11 to 16, average 13; grains per spikelet 2 to 3, average 2; one thousand weigh 572 grains.

3. LANCASTER, O. E. S.

Synonyms: *California Blue Stem*, O. E. S.; *Golden Drop*, O.E.S.; *Red Amber*, O.E.S.; *Scott*, O.E.S.; *Tasmanian*, O. E. S.; *Tasmanian Red*, Pat. Bros.

Spring growth quite upright, plants vigorous: Straw yellow, very weak: Panicle long bearded, bronze, glabrous, slightly loose, flattened, little tapering: Grain dark amber, extra large, long, slightly shrunken.

Culm: average height 3 feet 10 inches; diameter 1-8 to 1-5 inch, average 3-16.

Leaves: per culm 4; length 5 to 12 inches, average 8; width of upper leaf 3-8 to 7-8 inch, average 5-8; lower 3-16 to 3-8, average 3-4.

Panicle: average length 3 — inches; average thickness 3-8 inch; width 3-8 to 3-4 inch, average 1-2; spikelets 10 to 16, average 13; two to 5 seeded, average 4; one thousand weigh 787 grains.

A well-known variety. Mr. A. G. Boyd, of Hancock, Md., in a letter to the U. S. Dep't of Ag'l[1] says: "The Lancaster wheat . . . . is the earliest of our wheats . . . . and is in considerable demand with us."

4. MEDITERRANEAN, O. E. S.

Spring growth quite erect, vigorous, hardy: Straw whitish-yellow: Culms frequently decumbent: Panicle long bearded, light bronze, glabrous, nearly square, not very compact, abruptly pointed: Grain dark amber, large, long, contracted, yet not shrunken: Thrashes easily from glume.

Culm: average height 3 feet 6 inches; diameter 1-8 to 3-16 inch, average 3-16.

Leaves: per culm 4; length 4 to 11 1-4 inches, average 7 1 2; width of upper leaf 5-16 to 11-16 inch, average 1-2; lower 3-16 to 5-16, average 1-4.

Panicle: average length 3 ‡ inches; thickness 3-8 inch; breadth 3-8 to 5-8 inch, average 1-2.

Spikelets: 11 to 16, average 13; grains per spikelet 2-3, average 3; one thousand weigh 683 grains.

The earliest record I find of a wheat of this name being grown in America is, that it was introduced from Genoa, Italy, in 1819 by John Gordon, of Wilmington, Del.,[2] but no description accompanies this. It probably was introduced into Maryland[3] from the region of the Mediterranean sea, about 1837, from which locality it derived its name.

5. RED MEDITERRANEAN, ETT.

Culms rather weak: Panicles bearded very light bronze, almost white, glabrous, very loose, tapering: Grain medium to dark amber, large, long, slightly shrunken: Thrashes easily from glume.

Culm: average height 2 feet 10 inches, tallest plant 3 feet 3 inches; diameter 1-8 to 1-5 inch, average 3-16.

Leaves: per culm 4; length 4 to 12 inches, average 9; width of upper leaf 3-8 to 5-8 inch, average 1-2; lower 1-8 to 3-8 inch, average 1-4.

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[1] U. S. Dep't of Ag'l Report, 1862, p. 101.

[2] U. S. Dept. of Ag'l Report, 1863, p. 501.

[3] Trans. N. Y. State Ag'l Soc. 1843, p. 228.

Panicle: length average 5 + inches; thickness average 3-8 inch; breadth 1-2 to 3-4 inch, average 5-8; spikelets per panicle average 15; grains per spikelet 2 to 5, average 4.

6. SMITH'S IMPROVED, O. E. S.

Spring growth semi-erect, sparingly foliaceous: Straw yellow: Culms nearly erect, but not strong: Panicles medium to long bearded, bronze, glabrous, flat, loose, slightly tapering: Grain light amber, medium to large: Thrashes from glume very easily.

Culm: average height 3 feet 6 inches; diameter 1-8 to 1-4 inch, average 1-5.

Leaves: per culm 4; length of leaf 2 1-2 to 11 1-2 inches, average 8 ; width of upper leaf 1-4 to 11-16 inch, average 7-16 ; lower 1-8 to 3-8 inch, average 1-4.

Panicle : average length 4+inches ; thickness 3-8 to 7-16 inch, average 3-8 ; breadth 7-16 to 3-4 inch, average 5-8.

Spikelets : per panicle 10 to 20, average 18 ; grains per spikelet 2 to 4, average 3 ; one thousand weigh 602 grains.

7. SWAMP, O. E. S.

Growth medium and erect: Straw yellow: Culms weak and sprawling: Panicles medium long bearded, bronze, glabrous, flattened, loose, slightly tapering: Grain dark amber, large, long, slightly shrunken: Thrashes easily from glume.

Culm : average height 3 feet 6 inches; diameter 1-8 to 1-5 inch, average 1-7.

Leaves: per culm 4; length 4 to 11 1-2 inches, average 7 ; width of upper leaf 1-4 to 5-8 inch, average 3-8 ; lower 1-8 to 5-16, average 1-4.

Panicle : average length 3 1-4 ‡ inches ; thickness 3-8 to 7-16 inch, average 3-8; breadth 5-16 to 3-4 inch, average 5-8.

Spikelets : per panicle 11 to 20, averaging 15 ; grains per spikelet 2 to 3, average 2 ; one thousand weigh 717 grains.

8. VELVET CHAFF, O. E. S.

Spring growth rather decumbent: Straw whitish-yellow: Culms weak, of medium size: Panicles medium long bearded, of a dirty, dark ashy bronze color, the glumes being covered with a silvery pubescence: form somewhat flattened, compact, slightly tapering: Grain large, dark amber, slightly shrunken or plump: Thrashes hard from glume.

Culm : average height 3 feet 3 inches ; diameter 1-8 to 1-5 inch, average 1-7.

Leaves : per culm 4 ; length 4 1-2 to 13 inches, average 8 1-2 ; width of upper leaf 3-8 to 11-16 inch, average 7-16 ; lower 1-8 to 3-8 inch, average 3-16.

Panicle: average length 3+inches ; thickness, 3-8 to 1-2 inch, average 7-16 ; breadth 1-2 to 3-4 inch, average 5-8.

Spikelets: per panicle average 17; grains per spikelet 2 to 4, average 3; one thousand weigh 636 grains.

The name Velvet Chaff is commonly applied to all those varieties whose glumes are more or less villous. These varieties are both bearded and beardless, and have been known for years. Sinclair[1] under *Triticum vulgare* mentions one bearded and sixteen beardless varieties. One variety is described which must be, practically speaking, synonymous with this, viz.: "spike short, fleshy, turgid, awned; brownish; culm feeble." In growing many varieties at the Station, it has been noticed that the Velvet Chaff wheat of one form or another frequently appears. This has been remarked when the greatest pains have been taken to plant pure seed of varieties.

†† Panicle White.

9. BENNETT, O. E. S.

Spring growth wiry, and lying close to the ground: Straw whitish-yellow: Culms of medium size: Panicles long bearded, white, glabrous, compact and blunt at the tip, spikelets becoming gradually separated toward the base, and larger at the tip than base: Grain medium light amber, fairly long, slightly shrunken: Thrashes from glume medium well.

Culm: average height 3 feet, tallest plant 3 feet 5 inches; average diameter 1-5 inch.

Leaves: per culm 4; length 6 to 12 inches, averaging 9; width of upper leaf 3-8 to 5-8 inch, average 1-2; lower leaf 3-20 to 5-8 inch.

Panicle: average length 4 1-2+inches; average thickness 3-8 inch; breadth 1-2 inch; spikelets per panicle 14 to 20, average 18; grains per spikelet 2 to 4, average 3.

10. CHAMPLAIN, LAND.

Growth not very stocky: Culm with a weak tendency, and when well developed, inclined to fall to one side: Panicle long bearded, white, glabrous, loose tapering: Grain light, dull amber, small, short, plump or slightly shrunken: Thrashes hard from glume: Is a spring variety.

Culm: average height 2 feet 8 inches, tallest plant 3 feet 9 inches; diameter 1-7 to 1-4 inch, average 1-6.

Leaves: per culm 4; length of leaf 5 1-2 to 13 3-4 inches, average 9; width of upper leaf 5-16 to 11-16 inch, average 7-16; lower 1-8 to 3-8 inch, averaging 3-16.

Panicle: average length 5 1-2 ‡ inches; thickness 3-8 to 7-16 inch, average 3-8; breadth 3-8 to 3-4 inch, average 5-8; spikelets per panicle 20; grains 2 to 5, average 3.

Said to be a cross produced by G. C. Pringle, of Charlotte, Vt., in 1870, of Black Sea with the Golden Drop.

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[1] Hortus Gramineus Woburnensis. 1824 p. 114.

11. FRENCH IMPERIAL, JOHN.

Synonym: *New York Spring*, Thorb.

Culms not very stout, leaning usually to the ground, especially when large: Panicle long bearded, white, glabrous, very loose, tapering: Grain medium dark amber, sometimes mottled, of medium size, fairly plump, medium long: Thrashes from glume very well: A spring variety.

Culm: average height 3 feet 3 inches, tallest plant 4 feet 1 inch; diameter 1-8 to 1-5 inch, average 1-6.

Leaves: per culm 3, sometimes 4; length 4 3-4 to 15 1-2 inches, average 10; width of upper leaf 1-4 to 5 8 inch, average 7-16; lower 1-8 to 5-16 inch, average 3-16.

Panicle: average length 6 + inches; thickness 5-16 to 7-16 inch, average barely 3-8; breadth 5-16 to 11-16 inch, average 9-16; spikelets per panicle average 20; grains per spikelet 2 to 5, average 3.

12. GEIGER, BLOUNT.

Culms small and weak: Panicles bearded, white, glabrous, loose tapering, very irregular in length: Grain pale amber, of medium size, slightly shrunken, fairly long: Thrashes very good: A spring variety.

Culm: average height 2 feet 8 inches, tallest plant 3 feet 10; diameter 1-16 to 1-6 inch, average 1-8.

Leaves: per culm 4; length 4 to 10 inches, average 6 1-2; width of upper leaf 1-4 to 9-16 inch, average 3-8; lower 1-8 to 5-16 inch, average 3-16.

Panicle: average length 4 1-4 + inches; thickness 3 8 to 7-16 inch, avarage 3-8; breadth 1-2 to 3-4 inch, average 9-16; spikelets per panicle average 17; grains per spikelet 1 to 5, average 3.

13. HERISSON. VIL.

Synonym: *Herisson brun*, Vil.

Culm medium stout, short, and erect as a rule: Panicle short to medium long bearded, white, glabrous, compact, abruptly pointed, being noticeably larger at the top than at the base: Grain small, short, plump, dark amber or mottled: Thrashes very well from glume: A spring variety.

Culm; average height 2 feet 3 inches, tallest plant 2 feet 9 inches; diameter 1-8 to 1-5 inch, average 1-7.

Leaves: per culm 4; length 4 1-4 to 12 1-4 inches, average 8; width of upper leaf 1-4 to 9-16 inch, average 5-16; lower 1-8 to 5-16 inch, average 3-16.

Panicle: average length 2 3-4 + inches; thickness 3-8 to 7-8 inch, average 1-2; breadth 3-8 to 5-8, average 1-2; spikelets per panicle average 17; grains per spikelet 1 to 5, average 4.

Vilmorin says[1] that the origin of this variety is not well-known; he thinks that it comes from Southern Russia, as he has many times found it mixed with other wheats that came in a direct line from the Sea of Azof. It is at the present time grown in certain portions of France, and is thought to be especially suited to mountainous regions. Described by Vilmorin as bronze, but with us the glumes are distinctly white.

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[1] Les Meilleurs Bles., 1880, p. 114.

14. HUNGARIAN WHITE CHAFF, O. E. S.; P. & H.

Spring growth poor to fair, erect: Straw whitish-yellow: Culm weak, often reclining: Panicles long-bearded, white, glabrous, loose, tapering, flattened: Grain very clear dark amber, medium to long, plump or slightly contracted: Thrashes easily from glume.

Culm: average height 3 feet 10 inches; diameter 1-8 to 3-16 inch, average 1-8.

Leaves: per culm 4; length 4 to 11 1-2 inches, average 8, width of upper leaf 5-16 to 5-8 inch, average 1-2; lower 3-16 to 5-16 inch, average 3-16.

Panicle: average length 3 1-2 ‡; average thickness 3 8 inch; breadth 1-2 to 5-8 inch; average 1-2; spikelets per panicle 13 to 20, average 17; grains per spikelet 2 to 3, average 3; one thousand weigh 645 grains.

15. MAMMOTH, C. G.

Culms large but weak: Panicles very long bearded, white, glabrous, compact or nearly so, very slightly tapering: Grain white, very large, slightly shrunken, and short for the size.

Culm: average height 3 feet 2 inches, tallest plant 3 feet 7 1-2 inches; diameter 1-6 to 1-4 inch, average 1-5.

Leaves: per culm 4; length 8 to 15 1-2 inches, average 10; width of upper leaf 1-2 to 15-16 inch, average 5-8; lower 1-8 to 1-2 inch, average 1-4.

Panicle: average length 5 1-2+inches; thickness 3-8 to 1-2 inch, average, 1-2; breadth 5-8 to 3-4 inch, average 11-16; spikelets per panicle average 27; grains per spikelet 3 to 6, average 4; one hundred weigh 111 grains.

In 1883 the station received from the "Country Gentleman," at Albany, N. Y., an envelope containing a few seeds of a remarkably large, beautiful white wheat. The envelope had originally come from "The East Tennessee Seed Co.," Cleveland, Tenn., and on the outside was written, "The largest wheat in the world." The most active inquiry has failed to reveal more of the history of this variety. The heads are remarkable, one of which was 6 inches long and contained 31 spikelets. But the variety is not hardy for this latitude and goes through the winter badly. In order to shorten the name, I have designated this, Mammoth wheat, instead of adopting that sent to the Station, which was evidently more explanatory than otherwise.

16. MENNONITE, PAT. BROS.

Spring growth very poor, puny and grass like: Straw yellow: Culms rather weak, often sprawling: Panicles bearded, white, glabrous, flattened loose, tapering: Grain very dark amber, of medium size, much shrunken.

Culm: average height 2 feet 3 inches; diameter 1-8 to 3-16 inch, average 1-8.

Leaves: per culm 4; length 3 1-4 to 11 1-4 inches, average 7; width of upper leaf 1-4 to 7-16 inch, average 3-8; lower 1-8 to 1-4 inch, average 3-16.

Panicle: average length 3 inches; average thickness 3-8 inch; breadth 3-8 to 5-8, average 1-2; spikelets per panicle 9 to 18, average 14; grains per spikelet 1 to 4, average 2; one thousand weigh 533 grains.

This variety was introduced from Russia, by Mennonites, in 1882, according to a circular issued by Patterson Bros., Windfall, Ind., and was grown in this country for the first time in Kansas.

17. TREADWELL, O. E. S.

Synonym: *Democrat*, O. E. S.

Spring growth semi-erect and of medium vigor: Straw yellow: Culms fairly large, but inclined to weakness towards maturity: Panicles bearded, white glabrous, flattened, loose, tapering: Grain light amber, medium size, fairly long, slightly shrunken.

Culm: average height 3 feet six inches; diameter 1-8 to 1-4 inch, average 1-4.

Leaves: per culm 4; length 4 to 12 1-2 inches, average 8; width of upper leaf 5-16 to 3-4 inch, average 7-16; lower 1-8 to 5-16 inch, average 3-8.

Panicle: average length 3 3-4+inches; thickness 5-16 to 7-16 inch, average 3-8; breadth 3-8 to 3-4 inch, average 5-8; spikelets per panicle 13 to 20, average 17; grains per spikelet 2 to 4, average 3; one thousand weigh 571 grains.

18. VALLEY, O. E. S.

Spring growth erect and even: Straw yellow: Culms strong and erect, as a rule, though sometimes decumbent: Panicles bearded, white, glabrous, flattened, slightly loose, tapering: Grain dark amber or mottled, medium size, fairly long, contracted slightly: Thrashes from glume easily.

Culm: average height 3 feet 6 inches; diameter 1-8 to 1-6 inch, average 1-7.

Leaves: per culm 4; length 4 3-4 to 13 inches, average 8 1-2; width of upper leaf 1-4 to 5-8 inch, average 3-8; lower 1-8 to 5-16 inch, average 3-16.

Panicle: average length 3 1-4+inches; average thickness 3-8 inch; breadth 1-2 to 3-4 inch, average 5-8; spikelets per panicle 14 to 18, average 16; grains per panicle 3 to 4, averaging 4; one thousand weigh 559 grains.

19. WAYNE COUNTY SELECT, O. E. S.

Spring growth very erect, even and robust: Straw yellow: Culms stout and erect, medium to large: Panicles long bearded, white, glabrous, very compact, square, blunt at the tip, slightly tapering towards the base: Grain white, of medium size, short, plump: Thrashes from glume easily.

Culm: average height 3 feet 3 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4; length 5 1-4 to 12 1-2 inches, average 9; width of upper leaf 1-4 to 11-16 inch, average 7-16; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 2 3-4 ‡ inches; thickness increasing from 3-8 inch at base to 7-8 at tip, averaging 3-8 inch at base and 3-4 at tip; breadth 1-2 to 3-4 inch, average 5-8; spikelets per panicle 15 to 20, average 16; grains per spikelet 3 to 4, average 4; one thousand weigh 541 grains.

20. WHITE BLUE STEM, O. E. S.

Synonyms: *Egyptian*, O. E. S.; *Nigger*, O. E. S.; *Theiss*, O. E. S.

Spring growth semi-erect, medium stout: Straw yellow: Culms stout, usually erect: Panicles long beareed, white, glabrous, flattened, loose to compact, slightly tapering: Grain medium dark amber, medium size, long, plump or slightly shrunken: Thrashes from glume easily.

Culm: average height 2 feet 10 inches; diameter 1-8 to 1-5 inch, average 1-6.

Leaves: per culm 4; length 4 1-2 to 11 1-4 inches, average 8; width of upper leaf 5-16 to 11-16 inch, average 7-16; lower 1-8 to 3-8 inch, average 3-16.

Panicle: average length 4 ‡ inches; average thickness 3-8 inch; breadth 1-2 to 3-4 inch, average 5-8; spikelets per panicle 14 to 19, average 17; grains per spikelet 3 to 4, average 4; one thousand weigh 586 grains.

It is stated[1] that this variety was introduced into Jefferson Co., Ohio, in 1804, by Wm. Shannon, where it was grown for many years. Klippart is of the opinion that there is no doubt but that it is an offspring of "Flint" wheat, modified and improved. In the fall of 1843 it was distributed by the U. S. Patent Office.[2] There is no question but that many varieties have been known under this name of Blue Stem, a name derived from a bluish tint sometimes seen just beneath the panicle in the wheat plant.

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[1] Klippart, The Wheat Plant, 1859, p. 538.

[2] U. S. Patent Office Rep't, Agriculture, 1850, '51, p. 433.

21. WHITE VELVET, O. E. S.

Spring growth semi-erect, vigorous, abundantly foliaceous: Straw yellow: Culms not very stout, and usually somewhat reclining at maturity: Panicles bearded, white, villous with white silky hairs on glumes, fairly compact, flattened, tapering: Grain mottled or dark amber, medium to large, medium long, fairly plump: Thrashes from glume very well.

Culm: average height 3 feet 3 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4; length 5 to 12 1-4 inches, average 8; width of upper leaf 5-16 to 5-8 inch, average 7-16; lower 1-8 to 3-8, average 1-4.

Panicle: average length 3 1-4 + inches; thickness 3-8 to 7-16 inch, average 7-16; breadth 1-2 to 3-4 inch, average 5-8; spikelets per panicle 13 to 20, average 17; grains per spikelet 2 to 4, average 3; one thousand weigh 594 grains.

BEARDLESS WHEATS.

‡ Panicle bronze.

22. BORDEAUX, VIL.

Culms decumbent near the crown of the plant, then becoming very erect: very glaucous: Panicles beardless, bronze, glabrous, loose to compact, tapering: Grain medium dark amber, small, short, plump or shrunken: Separated hard from glume in thrashing.

Culm: average height 3 feet, tallest plant 3 feet 6 inches; diameter 1-8 to 1-5 inch, average 1-6.

Leaves: per panicle 4; length 6 to 13 1-2 inches, average 10 1-2; width of upper leaf 5-16 to 3-4, average 5 8; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 5 + inches; thickness 3-8 to 7-16 inch, average 7-16 ; breadth 7-16 to 5-8 inch, average 9-16 ; spikelets per panicle average 20; grains per spikelet 1 to 3, usually 2, often 0.

This variety is from France, and does not succeed in our climate, hence the frequency of no seeds developing in the spikelets.

23. CLAWSON, O. E. S.

Synonyms: *Gorham White*, Moff.; *Royal Australian*, O. E. S.; *White Eldorado*, O. E. S.; *White Mountain*, Alex.; *Winooski*, P. & H.

Spring growth strong and wiry: Straw yellow: Culms stout but rather inclined to lean: of medium size: Panicles beardless, glabrous, somewhat loose, flattened, slightly tapering: Grain white or mottled amber and white, of medium size, fairly long: Thrashes well from glume.

Culm : average height 3 feet 9 inches ; average diameter 1-5 inch.

Leaves: per culm 4; length of leaf 3 1-2 to 13 inches, average 9; width of upper leaf 1-2 to 3-4 inch, average 5-8; lower, average 3-8 inch.

Panicle: average length 4 ‡ inches; average thickness 3-8 inch; breadth 5-8 to 3-4 inch, average 5-8; spikelets per panicle 14 to 18, average 15; grains per spikelet 2 to 5, average 3; one thousand weigh 614 grains.

Original wheat found in a field of grain by Garrett B. Clawson, Ovid, N. Y., in 1870.

24. GERMAN AMBER, O. E. S.

Spring growth erect and sparingly foliaceous: Straw yellow: Culms weak, small to medium: Panicles beardless, bronze, glabrous, flattened, somewhat compact at tip, but loose at base: Grain dark amber, long, slightly shrunken: Thrashes easily from glume.

Culm: average height 3 feet; tallest plant 3 feet 9 inches; diameter 1-8 to 1-5 inch, average 1-5.

Leaves: per culm 4; length 4 1-2 to 12 inches, average 7; width of upper leaf 3-8 to 13-16 inch, average 1-2; lower 3-16 to 3-8 inch, average 1-4.

Panicle: average length 4 1-2 ‡ inches; thickness, average 3-8 inch; breadth 3-8 to 5-8 inch, average 1-2; spikelets per panicle 13 to 19, average 16; grains per spikelet 2 to 4, average 3; one thousand weigh 620 grains.

25. MCGHEE'S RED, O. E. S.

Spring growth vigorous, semi-erect: Straw whitish-yellow: Culms stout and erect: Panicles beardless, very light bronze, glabrous, loose, square, slightly tapering: Grain not easily separated from glume on thrashing.

Culm; average height 3 feet 3 inches; diameter 1-8 to 1-6 inch, average 1-6.

Leaves: per culm 4; length 4 1-2 to 13 inches, average 8 1-2; width of upper leaf 3-8 to 13-16 inch, average 9-16; lower 3-16 to 5-16 inch, average 1-4.

Panicle: average length 3 1-4 + inches; average thickness 3-8 inch; breadth 3-8 to 5-8 inch, average 1-2; spikelets per panicle 14 to 18, average 16; grains per spikelet 2 to 3, average 3; one thousand weigh 614 grains.

26. MCGHEE'S WHITE, O. E. S.

Spring growth of a paler green than McGhee's Red, small, semi-erect: Straw whitish-yellow: Culms fairly stout, erect: Panicles beardless, very light bronze, glabrous, loose, square or flattened, very slightly tapering: Grain white or very light amber, of medium size, short, plump.

Culm: average height 3 feet 3 inches; diameter 1-8 to 3-16 inch, average 3-16.

Leaves: per culm 4; length 3 1-4 to 11 inches, average 7;

width of upper 1-4 to 11-16, average 7-16 ; lower 1-8 to 1-4 inch, average 3-16.

Panicle : average length 3 1-4+inches ; thickness 5-16 to 3-8 inch, average 3-8 ; breadth 3-8 to 5-8 inch, average 1-2 ; spikelets per panicle 12 to 17, average 15 ; grains per spikelet 2 to 5, average 3 ; one thousand weigh 636 grains.

27. MICHIGAN AMBER, O. E. S.

Synonyms : *Pool*, O. E. S.; *Red Fultz*, O. E. S.; *Red Straw*, Sib.

Spring growth vigorous, semi-erect: Straw whitish-yellow: Culms usually stout and erect: Panicles beardless, bronze, glabrous, square, compact to loose, but slightly tapering: Grain dark amber, or sometimes mottled, medium size, long, plump, or slightly shrunken: Thrashes from glume very hard.

Culm : average height 3 feet 3 inches ; diameter 1-8 to 1-5 inch, average 3-16.

Leaves : per culm 4 ; length 4 1-2 to 10 1-4 inches, average 7 1-2 ; width of upper leaf 3-8 to 5-8 inch, average 1-2 ; lower 1-8 to 3-8 inch, average 1-4.

Panicle : average length 3 ‡ inches ; average thickness 3-8 inch ; breadth 3-8 to 5-8 inch, average 1-2 ; spikelets per panicle 11 to 17, average 15 ; grains per spikelet 2 to 3, average 3 ; one thousand weigh 586 grains.

The seed sent the Station of the Red Straw was white ; that of its progeny amber. Considering that that grown at the Station was identical in every respect with Pool and Red Fultz, synonyms of Michigan Amber, it has been thought best to place Red Straw along side of the others.

28. ROUSSELIN, VIL.

Culms erect and fairly stout, though not very stiff: Panicles beardless, medium dark bronze, glabrous, loose, tapering: Grain very pale amber, of medium size, and shrunken: Thrashes from glumes very well: a spring variety.

Culm : average height 2 feet 10 inches, tallest plant 3 feet 4 inches ; diameter 1-8 to 1-5 inch, average 1-7.

Leaves: per culm 4; length 4 3-4 to 15 1-2 inches, average 10; width of upper leaf 3-8 to 11-16 inch, average 9-16; lower 1-8 to 5-16 inch, average 3-16.

Panicle: average length 5 + inches; thickness 3-8 to 1-2 inch, average 7-16; breadth 7-16 to 5-8 inch, average 1-2; spikelets per panicle average 16; grains per spikelet usually 2, sometimes 3, often 0, being very variable.

A French variety, not adapted to this latitude.

29. SANDOMIRKA, O. E. S.

Spring growth not very strong, small, semi-erect: Straw whitish-yellow: Culms erect, though often somewhat decumbent: Panicles beardless, dull ashy bronze, glabrous, square or flattened, loose, tapering: Grain white or mottled amber and white, plump, medium size, short: Thrashes well from glume.

Culm: average height 3 feet 4 inches; diameter 1-8 to 3-16 inch, average 1-8.

Leaves: per panicle 4; length 3 to 11 1-2 inches, average 7; width of upper leaf 5-16 to 11-16 inch, average 7-16; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 3 ‡ inches; thickness 3-8 to 7-16 inch, average 3-8; breadth 3-8 to 3-4 inch, average 1-2; spikelets per panicle 12 to 21, average 16; grains per spikelet 2 to 4, average 3; one thousand weigh 548 grains.

Introduced from Poland.[1] This is evidently the Sandomir[2] wheat so well-known in portions of the United States 25 years ago, a variety extensively cultivated in Russia in the region of the Baltic and German seas. In Poland there are two varieties, bearded and beardless. The variety without beards is especially prized; is small, quite regular, of a red color, and is called Sandomir[3] wheat; the bearded is known as Szkalmirka wheat.

30. SEIGLE, VIL.

Synonym: *Rye Wheat*, (English name).

Culms quite erect, and medium stout: Panicles beardless, bronze, loose, tapering: Glumes covered with fine, silvery hairs: Grain pale amber, small, and much shrunken: Thrashes from glume with difficulty: A spring variety.

Culm: average height 2 feet 10 inches; tallest plant 3 feet 6 inches; diameter 1-8 to 1-5 inch, average 1-7.

Leaves: per culm 4; length of leaves 5 to 12 1-2 inches, average 9; width of upper leaves 3-8 to 3-4 inch, average 9-16; lower 1-8 to 5-16 inch, average 3-16.

Panicle: average length 5 + inches; thickness 3-8 to 7-16 inch, average 3-8; breadth 7-16 to 5-8 inch, average 9-16; spikelets per panicle average 19; grains per spikelet 2 to 3, very variable, and often 0.

This wheat is a French variety, and derives its name from the fact that it is mostly grown on land such as is employed for rye. Vilmorin says[4] that after many trials he has become convinced that *ble seigle* (Rye Wheat) is not suited to lands other than those adapted to rye.

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[1] Ohio Ag'l Ex. Station Report, 1882, p. 29.

[2] U. S. Patent Office Report, Agriculture 1861, p. 334.

[3] Ibid, p. 337.

[4] Les Meilleurs Bles, 1880, p. 96.

‡‡ Panicle white.

31. CANADA WINTER CLUB, JAQ.

Culms very stout, stiff, and erect, rising from a slightly decumbent base: Panicles beardless, white, glabrous, very compact and short, with spikelets crowded at the tip: blunt pointed, but tapering toward the base; very erect on the culm when ripe: Grain medium amber, short, plump: Thrashes hard from glume.

Culm: average height 2 feet 6 inches; tallest plant 3 feet; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4; length 4 to 9 1-2 inches, average 7; width of upper leaf 3-8 to 5-8 inch, average 1-2; lower 1-8 to 3-8 inch, average 1 4.

Panicle: average length 3 + inches; thickness varies from an average of 3-8 inch at the base, to 3-4 and 1 inch at the tip, with an average at tip of 3-4 inch; breadth 1-2 to 3-4 inch, average 5-8; spikelets per panicle average 21; grains per spikelet 3 to 6, average 5.

The original plant was found growing by J. S. Woodward, Esq., of Lockport, N. Y., in a field of wheat in 1882. Has not yet been placed on the market.

32. CHAMPION AMBER, O. E. S.

Spring growth vigorous, robust, erect: Straw yellow: Culms erect and stout: Panicles beardless, white, glabrous, rather loose, flattened, somewhat tapering: Grain dark amber, medium to large, long, shrunken: Thrashes hard from glume.

Culm: average height 3 feet 6 inches; diameter 1-8 to 1-5 inch, average 1-5.

Leaves: per culm 4; length 4 1-2 to 9 1-2 inches, average 7; width of upper leaf 1-2 to 7-8 inch, average 5-8; lower, average 3-8 inch.

Panicle: average length 3 1-2 + inches; average thickness 1-2 inch; average breadth 5-8 inch; spikelets per panicle 16 to 22, average 17; Grains per spikelet, average 3; one thousand weigh 502 grains.

33. CRYSTAL ROCK, ALEX.

Culms very large, stiff and erect: Panicles beardless, white, glabrous, fairly compact, abruptly pointed: Grain light amber, very short, broad, shrunken: Thrashes very hard from glume: A spring variety.

Culm: average height 3 feet, tallest plant 3 feet 8 1-2 inches; diameter 1-7 to 1-4 inch, average 1-5.

Leaves: per culm 4; length 6 to 11 3-4 inches, average 9; width of upper leaf 1-2 to 13-16 inch, average 5-8; lower 3-16 to 3 8 inch, average 1-4.

Panicle: average length 5 1-2 + inches; thickness 3-8 to 1-2 inch, average 1-2; breadth 1-2 to 5-8 inch, average 9-16; spikelets per panicle average 23; grains per spikelet 2 to 4, average 2.

34. FULTZ, O. E. S.

Synonyms : *Finley*, O. E. S.; *Heighe's Prolific*, O. E. S.; *Rocky Mountain*, O. E. S.; *Travis*, O. E. S.; *Yellow Blue Stem*, O. E. S.

Spring growth good and well matted: Straw yellow; Culms stout, erect: Panicles beardless, white, glabrous, fairly compact, slender, nearly square, tapering: Grain dark amber, small to medium, short, fairly plump: Thrashes hard from glume.

Culm : average height 3 feet 6 inches ; diameter 3-16 to 1-5 inch, average 1-5.

Leaves : per culm 4 ; length 3 3-4 to 10 1-2 inches, average 7 1-2 ; width of upper leaf 3-8 to 3-4 inch, average 1-2 ; lower 1-4 to 3-8 inch, average 1-4.

Panicle : average length 3 1-4 + inches; average thickness 3-8 inch ; breadth 1-2 to 3-4 inch, average 5-8 ; spikelets per panicle 11 to 18, average 15 ; grains per spikelet 2 to 4, and very variable ; one thousand weigh 509 grains.

This variety was discovered by Abraham Fultz,[1] of Mifflin Co., Penn., in a field of Lancaster wheat, in the summer of 1862. It has been widely distributed by the U. S. Department of Agriculture, and is to-day one of our best known varieties.

35. FULTZO-CLAWSON, BRAD.

Spring growth backward, very decumbent, not stout: Straw yellow: Culms fairly stout, erect, excepting a slight decumbency at base: Panicles beardless, white, glabrous, very loose, flattened, slightly tapering: Grain very dark, extra large, long, plump or slightly shrunken: Thrashes hard from glume.

Culm : average height 3 feet 6 inches ; diameter 1-8 to 1-4 inch, average 3-16.

Leaves : per culm 4 ; length 3 to 12 1-2 inches, average 7 1-2 ; width of upper leaf 3-8 to 7-8 inch, average 1-2 ; lower 1-8 to 3-8 inch, average 1-8.

Panicle : average length 4+inches ; average thickness 3-8 inch ; breadth 3-8 to 3-4 inch, average 1-2 ; spikelets per panicle 13 to 18, average 16 ; grains per spikelet 2 to 5, average 2 ; one thousand weigh 810 grains.

36. GOLD DUST, CRIST.

Synonym : *Extra Early Oakley*, Dep't Ag'l.

Culms fairly stout: Panicles beardless, white, glabrous, loose to compact, tapering: Grain medium dark amber, short, plump, medium to small: Thrashes very well from glume.

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[1] U. S. Dep't Ag'l Report, 1871, p 133.

Culm: average height 2 feet 10 inches, tallest plant 3 feet 7 inches; diameter 1-8 to 1-5 inch, average 3-16.

Leaves: per culm 4; length 3 3-4 to 10 3-4 inches, average 6 1-2; width of upper leaf 3-8 to 3-4 inch, average 1-2; lower 3-16 to 3-8 inch, average 1-4.

Panicle: average length 4 1-2 + inches; average thickness 3-8 inch; breadth 3-8 to 3-4 inch, average 5-8; spikelets per panicle, average 18; grains per spikelet 2 to 6, average 4.

37. GOLDEN STRAW, O. E. S.

Synonym: *White Rogers*, O. E. S.

Spring growth poor, somewhat erect, small: Straw whitish-yellow: Culms usually erect, stout: Panicles beardless, white, glabrous, fairly compact, slender, nearly square, tapering: Grain amber, medium size, short to medium, plump: Thrashes very easily from glume.

Culm: average height 3 feet 3 inches; diameter 1-8 to 1-5 inch, average 3-16.

Leaves: per culm 4; length 3 to 12 inches, average 7 1-2; width of upper leaf 3-16 to 3-4 inch, average 1-2; lower 1-8 to 1-4 inch, average 3-16.

Panicle: average length 3 ‡ inches; average thickness 3-8 inch; breadth 3-8 to 3-4 inch, average 5-8; spikelets per panicle 12 to 18, average 16; grains per spikelet 2 to 4, average 3; one thousand weigh 509 grains.

Klippart[1] records this variety, and his description corresponds with the variety as grown to-day, as having been cultivated in Lawrence Co., Ohio, in 1844.

38. LANDRETH, O. E. S., EAST.

Synonym: *Martin's Amber*, O. E. S., Ever.

Spring growth good, partly erect, strong, producing an abundance of foliage: Straw whiteish-yellow: Culms very erect and stout: Panicle beardless, white, glabrous, slightly loose, not being really compact, flattened, tapering: Grain white or light amber, medium size, short to medium long, plump: Thrashes from glume very well.

Culm: average height 3 feet 10 inches; diameter 3-16 to 1-5 inch, average 1-5.

Leaves: per culm 4; length 5 1-4 to 13 1-2 inches, average 8; width of upper leaf 3-8 to 3-4 inch, average 9-16; lower, 3-16 to 3-8 inch, average 1-4.

Panicle: average length 4 ‡ inches; thickness average 3-8 inch; breadth 1-2 to 3-4 inch, average 5-8; spikelets per panicle 16 to 20, average 18; grains per spikelet 2 to 4, average 3; one thousand weigh 564 grains.

This variety was originally found growing in a field of

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[1] The Wheat Plant, Klippart, 1859, p. 528.

Clawson wheat on the farm of H. S. Bonnell,[1] Junius, Seneca Co., N. Y., in 1877. This Mr. Bonnell planted the following year, and continued his planting until 1881, when he had about 10 acres. In 1881 Mr. W. L. Eastman, of Ovid, Seneca Co., obtained seed from Mr. Bonnell, and the following year secured Mr. B's entire crop and negotiated with D. Landreth & Sons, of Philadelphia, for its dissemination. In 1882, Landreth & Sons placed this variety upon the market, under the name it now bears. A careful comparison of this and the so-called Martin's Amber, both in the experimental plat and on the farm, in the field, has led me to declare them synonymous.

39. MILLER'S GENESEE PROLIFIC, MILL.

Culms short, unusually stiff, stout, and very erect, and the general form of the plant compact: Panicles beardless, white, glabrous, short, very compact, and much crowded at the tip, very blunt pointed, tapering towards the base: Grain medium light amber, small to medium, short, plump: Thrashes very hard from glume.

Culm: average height 2 feet 3 inches, tallest plant 2 feet 10 inches; diameter 1-8 to 1-4 inch, average 1-5.

Leaves: per culm 4; length 3 3-4 to 10 1-2 inches, average 7; width of upper leaf 5-16 to 5-8 inch, average 1-2; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 2 1-4 + inches; the thickness gives an average variation from 3-8 at base to 1 inch at tip; breadth 1-2 to 5-8 inch, average 1-2; spikelets per panicle average 17; grains per spikelet 2 to 5, average 4.

Discovered in a field of Arnold's Gold Medal, by Mr. James Miller, Penn Yan, N. Y., in 1878. Not yet much introduced.

40. NONPAREIL, SIB.

Synonym: *Fountain*, Blount.

Culms very erect and stiff, though small: Panicles beardless, white, glabrous, fairly compact, slightly tapering, small: Grain light amber, small to medium, long, badly shrunken: Thrashes very hard from glume. A spring variety, all fall plants being winter killed.

Culm: average height 3 feet, tallest plant 3 feet 10 inches; diameter 1-8 to 1-6 inch, average 1-7.

Leaves: per culm 4; length 5 to 11 1-4 inches, average 8 1-2; width of upper leaf 3-8 to 5-8 inch, average 1-2; lower 1-8 to 5-16 inch, average 3-16.

Panicle: average length 4 1-2 — inches; thickness 3-8 to 1-2 inch, average 7-16; breadth 7-16 to 5-8 inch, average 1-2; spikelets per panicle average 19; grains per spikelet 2 to 4, average 2.

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[1] Rural New Yorker, January, 1884.

41. PURPLE STRAW, BLOUNT.

Culms very erect and stiff, but small: Panicles beardless, white, glabrous, fairly compact, tapering, small, slender: Grain medium dark amber, small, slender, shrunken: Thrashes quite easily from glume.

Culm: average height 2 feet 8 inches; tallest plant 3 feet 7 inches; diameter 1-8 to 1-6 inch, average 1-7.

Leaves: per culm 4; length 5 to 10 3-4 inches, average 7; width of upper leaf 3-8 to 5-8 inch, average 7-16; lower 1-8 to 1-4 inch, average 3-16.

Panicle: average length 3 1-2 + inches, thickness 5-16 to 7-16 inch, average 3-8; breadth 5-16 to 9-16 inch, average 7-16; spikelets per panicle average 18; grains per spikelet 1 to 4, usually none, sometimes 2.

This variety winter kills at the Station, and when grown as a spring variety amounts to nothing, the seeds developing very poorly, and the whole plant making a poor showing.

42. RUSSIAN MAY, O. E. S.

Synonym: *Russian No.* 2, O. E. S.

Spring growth small, semi-erect, with sparse foliage: Straw yellowish-white: Culms fairly stout, erect: Panicles beardless, white, glabrous, square, compact, abruptly pointed, the tip being slightly larger, if anything, than the base: Grain dark amber or mottled, smaller than medium, short, slightly shrunken: Thrashes from glume easy.

Culm: average height 3 feet; diameter 1-7 to 1-5 inch, average 3-16.

Leaves: per culm 4; length 3 3-4 to 10 1-2 inches, average 7 1-2; width of upper leaf 1-4 to 5-8 inch, average 1-2; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 3 1-4 + inches; thickness varying on an average from 3-8 inch at base to 5-8 inch at tip; breadth 3-8 to 11-16 inch, average 5-8; spikelets per panicle 14 to 21, average 17; grains per spikelet 2 to 4, average 3; one thousand weigh 409 grains.

43. RUST PROOF, BLOUNT.

Culms small, very stiff and erect: Panicles beardless, white, glabrous, loose, slender, tapering: Grain pale amber, medium size, fairly long, plump: Thrashes from glume first rate: not rust proof. A spring variety.

Culm: average height 3 feet, tallest plant 3 feet 10 inches; diameter 1-10 to 1-6 inch, average 1-8.

Leaves: per culm 4; length 4 to 10 1-2 inches, average 7; width of upper leaf 3-8 to 11-16 inch, average 1-2; lower 1-8 to 3-8 inch, average 3-16.

Panicle: average length 4+inches; thickness 3-8 to 7-16 inch, average 3-8; breadth 3-8 to 5-8 inch, average 1-2;

spikelets per panicle average 17 ; grains per spikelet 2 to 5, average 3.

Prof. Blount writes that he secured this variety from North Carolina, in 1882.

44. SASKATCHEWAN FIFE, J. & S.

Synonyms : *Saskatchewan Spring*, Hend.; *Scotch Fife*, Sprag.

Culms very erect and stiff: Panicles beardless, white, glabrous, loose, tapering: Grains, dark amber, small, very short and plump: Thrashes hard from glume: A spring variety.

Culm : average height 3 feet 2 inches, tallest plant 3 feet 9 inches ; diameter 1-8 to 1-4 inch, average 1-6.

Leaves : per culm 4 ; length 6 to 12 inches, average 9 ; width of upper leaf 5-16 to 11-16 inch, average 1-2 ; lower 1-8 to 3-8 inch, average 3-16.

Panicle : average length 5 ‡ inches ; thickness 5-16 to 7-16 inch, average 3-8 ; breadth 1-2 to 5-8 inch, average 9-16 ; spikelets per panicle average 20 ; grains per spikelet 2 to 4, average 3.

This variety is principally grown in Dakota, Minnesota, and the Northwest, the original stock coming from Manitoba, where it has been grown for 20 years or more under the name of Scotch Fife.

45. SAUMUR, VIL.

Synonym : *Summer* (English name).

Culms erect, but not very stout: Panicles beardless, white, glabrous, slightly compact, tapering: Grain dark amber, medium to large, short, much shrunken: Thrashes from glume with difficulty: A spring variety.

Culm : average height 3 feet, tallest plant 3 feet 7 inches; diameter 1-7 to 1-5 inch, average 1-6.

Leaves : per culm 4 ; length 6 to 15 inches, average 11 1-2 ; width of upper leaf 1-2 to 7-8 inch, average 11-16 ; lower 1-8 to 3-8, average 1-4.

Panicle : average length 4 1-4+inches ; thickness 3-8 to 1-2 inch, average 7-16; breadth 3-8 to 5-8 inch, average 9-16; spikelets per panicle average 20 ; grains per spikelet 1 to 4, average 2, often none.

A well known French wheat much cultivated in the vicinity of Paris. A description of this wheat as grown here, varies in some respects with the plant grown in France, where the climate is much better suited to its complete development. Vilmorin[1] describes this variety as follows :

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[1] Les Meilleurs Bles, 1880, p. 72.

Straw short, rather stout, slender and erect. Head erect, medium size, slightly tapering, a little flattened upon the face of the spikelets. Grain yellow or pale red, soft, short, slightly obtuse at both ends.

46. SILVER CHAFF, O. E. S.

Synonyms: *Grecian*, O. E. S.; *Treadwell*, O. E. S.; *York White Chaff*, O. E. S.

Spring growth semi-erect and good: Straw yellow: Culms stout and usually erect: Panicles beardless, white, glabrous, flattened, compact, slightly tapering: Grain medium to light amber, medium to large, fairly plump: Thrashes from glume fairly well.

Culm: average height 3 feet 6 inches; diameter 1-8 to 1-5 inch, average 1-6.

Leaves: per culm 4; length 4 to 11 1-2 inches, average 7 1-2; width of upper leaf 1-4 to 3-4 inch, average 7-16; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 3 3-4+inches; thickness 3-8 to 7-16 inch, average 3-8; breadth 3-8 to 3-4 inch, average 5-8; spikelets per panicle 13 to 21, average 17; grains per spikelet 2 to 4, average 3; one thousand weigh 586 grains.

It is stated[1] that this variety came from California.

47. SURPRISE, BRAD.

Culms stout and usually quite erect, though often decumbent at the base for a short distance: Panicles beardless, white, glabrous, very compact, larger at tip than base: Grains fairly light amber, medium size, fairly long, plump or slightly shrunken: Thrashed easy from glume.

Culm: average height 2 feet 6 inches, tallest plant 3 feet 1 inch; diameter 1-8 to 1-4 inch, average 1-5.

Leaves: per culm 4; length 4 to 10 1-2 inches, average 7 3-4; width of upper leaf 5-16 to 11-16 inch, average 1-2 inch; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 3 3-4+inches; average thickness 3-8 inch at base, and 5-8 at tip; breadth 1-2 to 7-8 inch, average 3-4; spikelets per panicle average 18; grains per spikelet 3 to 7, average 5.

48. TAPPAHANNOCK, O. E. S.

Synonym: *Boughton.*

Culm weak and spreading, though occasionally erect: Panicles beardless white, glabrous, somewhat loose, tapering; Grain light amber, medium size, usually plump, short: Thrashes from glume easily.

Culm: average height 2 feet 6 inches, tallest plant 3 feet 7 inches; diameter 1-8 to 1-5 inch, average 1-8.

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[1] Sibley's Seed Catalogue, 1883, p. 130.

Leaves: per culm 4; length 3 to 10 1-4 inches, average 6 3-4; width of upper leaf 3-8 to 5-8 inch, average 3-8; lower 1-8 to 3-16 inch, average 3-16.

Panicle: average length 3 1-2+inches; thickness 5-16 to 3-8 inch, average 3-8; breadth 3-8 to 3-4 inch, average 9-16; spikelets per panicle average 16; grains per spikelet 2 to 6, average 4.

This variety was discovered[1] in May, 1854, by a Mr. Boughton, of Essex Co., Va., in a field of wheat. Since then it has had a wide dissemination, and especially since 1862, when it was distributed by the U. S. Dep't of Agriculture. Klippart[2] states that it is a variety of the Genesee Flint, and that it was introduced into Ohio from Virginia in 1858.

49. WASHINGTON GLASS, O. E. S.

Culm large but weak, and plants sprawling: Panicles beardless, white, glabrous, loose to compact, the tip usually being compact and blunt, the base quite loose: Grain fairly light amber, very large, slightly shrunken: Thrashes hard from glume.

Culm: average height 3 feet 3 inches; diameter 1-7 to 1-4 inch, average 1-6.

Leaves: per culm 4; length 6 to 13 inches, average 9 1-2; width of upper leaf 3-8 to 15-16 inch, average 9-16; lower 1-8 to 1-2 inch, average 1-4.

Panicle: average length 5+inches; thickness 3-8 to 1-2 inch, average 7-16; breadth 1-2 to 7-8 inch, average 13-16; spikelets per panicle 16 to 21, average 19; grains per spikelet 2 to 5, average 4; one thousand weigh 687 grains.

50. WHITE RUSSIAN, J. & S.

Synonyms: *Green Mountain*, Greg.; *Pringle's Green Mountain*, J. & S.

Culms erect, though decumbent at the base; and not very stout: Panicles beardless, white, glabrous, very long, loose, tapering, flattened: Grain dark amber, medium size, fairly long, sparingly plump: Thrashed from glume very well: A spring wheat.

Culm: average height 3 feet, tallest plant 4 feet; diameter 1-7 to 1-4 inch, average 1-6.

Leaves: per culm 4; length of leaf 6 to 12 1-2 inches, average 9; width of upper leaf 3-8 to 11-16 inch, average 1-2; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 6+inches; thickness 3-8 to 7-16 inch, average 3-8; breadth 7-16 to 3-4 inch, average 5-8;

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[1] U. S. Dep't Ag'l Report, 1872, p. 410.

[2] The Wheat Plant, Klippart, 1859, p. 531.

spikelets per panicle average 20 ; grains per spikelet 2 to 5, average 3, often 4.

D. M. Ferry & Co., Detroit, Mich., claim[1] to have introduced this variety in 1879.

51. ZIMMERMAN, O. E. S.

Synonyms: *Rice*, O. E. S.; *Early Rice*, Pat. Bros.; *Scott*, O. E. S.

Spring growth rather decumbent and weakly: Straw whitish-yellow: Culms erect and stout as a rule: Panicles beardless, white, glabrous, ranging from compact to loose, flattish, slightly tapering: Grains dark amber, medium to large, fairly plump or slightly shrunken: Thrashes medium well from glume.

Culm: average height 3 feet 4 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4; length 4 1-2 to 11 1-2 inches, average 8; width of upper leaf 1-4 to 11-16 inch, average 3-8 inch; lower 1-8 to 5-16 inch, average 3-16.

Panicle: average length 3 1-2 + inches; thickness 5-16 to 1-2 inch, average 3-8; breadth 1-2 to 11-16 inch, average 5-8; spikelets per panicle 11 to 20, average 17; grains per spikelet 2 to 4, average 3; one thousand weigh 701 grains.

This is an old variety first grown in America in the Eastern States, where it was looked upon with favor. Probably introduced from Europe not far from and prior to 1850.[2]

TRITICUM DURUM, DESF.

This is what is termed "hard wheat." This species differs markedly from *sativum* in several respects. The straw is long and slender, is filled with a pith, and in consequence is quite hard. The plant tillers to but a slight extent. The panicles are all square and bearded. The grain is so hard that it is difficult to mill and averages larger than with common wheat. Heuzé[3] says that its flour, which is always yellowish, is used in making vermicella, semoules, Italian pastry and excellent bread. This wheat is grown mostly in Europe and Africa, on the islands of the Mediterranean, in the countries of Southern Spain, Greece, Turkey, Southern Russia, Syria, Egypt and Algiers. It has been grown some in the United States, but to no great extent, not being adapted to our northern wheat belt.

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[1] D. M. Ferry & Co.'s Catalogue, 1883, p. 69.

[2] U. S. Patent Office Report, Agriculture, 1851, p. 298.

[3] Les Plantes Alimentaires, 1872 t. 1, p. 111.

1. BELOTOURKA, VIL.

Culms very tall, slender and weak, and apparently unable to sustain the fully developed panicles, many culms lying flat upon the ground at maturity: Panicles very long bearded, dirty yellow, very compact yet not crowded, glabrous, noticeably glaucous when ripe, square, tapering but slightly: Grain very pale yellow-amber, large, long, slightly shrunken, and very hard: Thrashes rather hard from the glume: A spring wheat.

Culm: average height 3 feet 3 inches, tallest plant 4 feet; diameter 1-8 to 1-5 inch, average 1-7.

Leaves: per culm 4; length 5 1-2 to 13 1-4 inches, average 10 1-2; width of upper leaf 5-16 to 13-16 inch, average 1-2; lower 1-8 to 1-2 inch, average 3-16.

Panicle: average length 3 + inches; thickness 7-16 to 3-4 inch, average 9-16 inch; breadth 3-8 to 5-8 inch, average 1-2; spikelets per panicle average 19; grains per spikelet 2 to 5, average 4.

Although Vilmorin states[1] that this variety has a filled straw, that grown at the Station from seed sent here by Vilmorin, Andrieux et Cie, was hollow, though the sides of the culms were much thicker than with varieties of *sativum*. This may be owing to the fact that our climate is not really suited to the variety, as the grain does not have the perfect development that it does in Europe and Africa. Supposed to be from Southern Russia.

2. EGYPTIAN, DEP'T OF AG'L.

Culms large, long but very weak, and solid, excepting in the larger part of the straw between the nodes, where a very small cavity exists: Panicle very long bearded; glumes dirty yellow, often with edges blackish tinted, and flowering glumes tipped with long brown or brown-black awns; glabrous, glaucous, compact though not crowded, square, and but slightly tapering: Grain medium light amber, large, long, very hard, shrunken: Thrashes from glume rather hard: A spring wheat.

Culm: average height 3 feet 6 inches, tallest plant 4 feet 4 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4; length 5 1-2 to 16 inches, average 9; width of upper leaf 3-8 to 13-16 inch, average 5-8; lower 1-8 to 7-16 inch, average 5-16.

Panicle: average length 3 1-2 + inches; thickness 7-16 to 11-16 inch, average 5-8; breadth 1-2 to 3-4 inch, average 5-8; spikelets per panicle average 20; grains per spikelet 2 to 5, average 4.

This variety was distributed by the U. S. Dep't of Ag'l in 1885, as an imported winter wheat. It was planted in the fall, and during the winter all the plants were destroyed by cold. It is not the true Egyptian wheat known as *Triticum compositum*, or Miracle wheat, having a branching panicle, but has a simple head like other varieties.

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[1] Les Meilleurs Blés, 1880, p. 140.

3. SILVER MEDAL, SEAV.

Growth vigorous and early: Straw yellow: Culms stocky, hollow, thick walled, but falling to the ground from weight of panicles when near maturity: Panicles long bearded, glumes and awns fawn-colored, glabrous, very glaucous, compact, slightly tapering: Grain pale amber, large, long, plump or slightly contracted, and excessively hard; on being thrashed does not readily separate from the flowering glume: A spring variety.

Culm: average height 3 feet 8 inches, tallest plant 4 feet 6 inches; diameter 1-8 to 1-5 inch, average 1-6.

Leaves: per culm 4; length 6 1-2 to 14 inches, average 9 1-2; width of upper leaf 3-8 to 3-4 inch, average 9-16; lower 1-8 to 7-16 inch, average 1-4.

Panicle: average length 3 1-2+inch; thickness 1-2 to 9-16 inch, average 1-2; breadth 7-16 to 5-8 inch, average 9-16; spikelets per panicle average 21; grains per spikelet 2 to 4, average 3, often 4.

This variety has been cultivated in Onondago Co., New York State, to some extent, but its growth was discontinued, the millers refusing to handle it on account of its hardness. That grown by the Station was from a gentleman who had found it necessary to cease growing it, owing to the above reason.

4. WHITE CRIMEAN, DEP'T AG'L.

Culms long, of good size, solid, excepting to a very slight extent in the larger part between the nodes, but very weak and unable to support a fully matured panicle, always falling over when of full size, and very glaucous: Panicles long bearded, white, both awns and glumes, glabrous, glaucous, compact yet not crowded, square, slightly tapering: Grain pale amber, very large, long, shrunken slightly: Thrashes hard from glume: A spring variety.

Culm: average height 3 feet 1 inch, tallest plant 3 feet 7 inches; diameter 1-8 to 1-5 inch, average 1-6.

Leaves: per culm 4; length 7 to 13 inches, average 10; width of upper leaf 3-8 to 11-16 inch, average 1-2; lower leaf 1-8 to 7-16, average 5-16.

Panicle: average length 3 1-2+inches; thickness 1-2 to 5-8 inch, average 5-8; breadth 1-2 to 3-4 inch, average 5-8; spikelets per panicle average 19; grains per spikelet 2 to 5, average 4.

This variety was distributed in 1885 by the U. S. Dep't of Ag'l as a winter wheat, and was planted as such, but entirely winter-killed. It is stated by the department that this is an imported variety.

TRITICUM POLONICUM, L.

POLOGNE OU ASTRAKAN, VIL.

Synonyms: *Polish*, *Astrakan* (English names).

There is but one variety of this species, hence the description may all be included under the name of the variety.

Culms of good size, solid, being filled with cellular tissue, but weak, and long before maturity arrives falling to the ground: Panicles bearded to a greater or less extent; awns usually short; glumes very large and long, projecting far beyond the flowering glumes as a rule, in a very striking manner; whitish-yellow; panicle very long, loose, taperinng: Grain medium pale amber, extra long, inclined to be slender, rather shrunken: Thrashes from glume rather easily: a spring variety.

Culm: average height 2 feet 10 inches, tallest plant 3 feet 11 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4; length 4 1-2 to 14 inches, average 11; width of upper leaf 1-4 to 3-4 inch, average 7-16; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 6 1-2 + inches; thickness 7-8 to 1 1-4 inch, average 3-4; breadth 7-8 to 1 1-8 inch, average 3-4; spikelets per panicle average 18; grains per spikelet 1 to 5, usually 2.

Notwithstanding the large size of the panicles of this wheat, they are not very productive of grain, most of the spikelets usually containing some sterile flowers. This variety originally came from South-eastern Asia.[1] It is mostly grown in Northern Africa in Egypt and Algiers.[2] It is also grown to some extent in Europe, and has been sold in the United States under the names Polish and Diamond. It is a hard wheat, and is not a profitable variety for this latitude. Its grain is mostly used in fine pastry.

TRITICUM SPELTA, L.

The grain of this species is enclosed in the flowering glume, and remains within it even after thrashing, the panicle merely breaking at the various joints of the rachis, separating the spikelets, leaving them entire, with the grain enclosed within the glumes which are very tough and leathery. The panicles are long and slender, and usually have the spikelets widely separated. These wheats are commonly grown in the less fertile, mountainous regions of Europe and Asia, in Lorraine, in Central Germany, Russia and India. The grain makes a very white, fine class of pastry.

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[1] Les Plantes Alimentaires, Heuze 1872 t. 1, p. 124.

[2] Les Meilleurs Blés, 1880, p. 144.

1. EPEAUTRE BLANC BARB, VIL.

Synonym: *Bearded White Spelt* (English name).

Culms large, strong, hollow, very erect, although nearly all are strikingly decumbent at the base for a short distance; elliptical to a certain degree, not being perfectly round: Panicles bearded, white, glabrous, very long, slender and tapering from base to tip: Spikelets narrow, widely separated on the rachis: Grain medium dark amber, medium to large in size, long, fairly plump: A spring variety.

Culm: average height 2 feet 3 inches, tallest plant 3 feet 4 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 3, almost always; length 5 to 12 inches, average 8; width of upper leaf 1-4 to 11-16 inch, average 7-16; lower 1-10 to 1-4 inch, average 1-8.

Panicle: average length 6 + inches; thickness 5-16 to 7-16 inch, average 3-8 at base; breadth 5-16 to 7-16 inch, average 3-8 ; spikelets per panicle average 19; grains per spikelet 2 to 3, average 3.

2. EPEAUTRE NOIR BARBU, VIL.

Synonym: *Bearded Black Spelt* (English name).

Culms hollow when well developed, quite weak, reclining on the ground; very glaucous; Panicles bearded, dark brown-black, glabrous, glaucous, very long, loose, gradually tapering from base to tip; awns short, spreading, coarse; Grain medium dark amber, large, long, shrunken: A spring variety, and tillers strikingly.

Culm: average height 3 feet, tallest plant 4 feet; diameter 1-8 to 1-4 inch, average 1-5.

Leaves: per culm 4; length 6 1-4 to 13 1-2 inches, average 10 1-2; width of upper leaf 3-8 to 13-16 inch, average 9-16; lower 1-8 to 5-16 inch, average 3-16.

Panicle: average length 7 1-2 inches, some attaining a length of 9 inches; thickness 3-8 to 1-2 inch, average 7-16; breadth 3-8 to 1-2 inch, average 7-16; spikelets per panicle average 22; grains per spikelet 2 to 4, average 3.

TRITICUM AMYLEUM, SER.

This species is closely related to *spelta* but there are two very striking differences, viz: the panicle is compact, and the spikelets closely lap over each other, the sides of the panicle being smooth and not presenting an irregular surface. The grain is shuttle form, very hard, and thin skinned, enclosed in the glume. The awns are usually much longer than in case of *T. spelta*. This species is mostly grown in the mountainous parts of Central Europe. The grain is especially used in the manufacture of starch.

1. AMIDONNIER BLANC, VIL.

Synonym: *Epeautre de Tartarie*, Vil.; *White Starch Wheat* (English name).

Culms generally stiff and erect, though when very long frequently reclining, hollow, very glaucous: Panicles bearded, white, glabrous, glaucous, compact, tapering; awns widely divergent and slender; spikelets often proliferous, especially with the central ones; Grain medium dark amber, of good size, long, somewhat shrunken: A spring variety.

Culm: average height 3 feet 4 inches, tallest plant 4 feet 2 1-2 inches; diameter 1-7 to 1-4 inch, average 1-6.

Leaves: per culm 5; length 7 to 13 3-4 inches, average 10 1-2; width of upper leaf 3-8 to 3-4 inch, average 9-16; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 5 + inches; thickness 5-16 to 3-8 inch, average 3-8; breadth 5-16 to 3-8 inch, average 5-16; spikelets per panicle average 28; grains per spikelet 2 to 3, average 2.

This variety can be cultivated in cold mountainous regions where no other wheat can be raised, excepting, perhaps, *Triticum monococcum*, the next species to be considered. It has been grown for a long time in certain infertile regions of Alsace and the Palatinate, in Germany.

2. AMIDONNIER ROUX, VIL.

Synonym: *Red Starch Wheat* (English name).

Culms hollow, slender, glaucous, very erect, stiff; nodes whiteish and hairy; Panicles bearded, very light bronze, glabrous, compact, slightly tapering; awns long, slender, divergent: Grains medium pale amber, of fair size, long; a spring variety.

Culm: average height 3 feet, tallest plant 3 feet 5 inches; diameter 1-12 to 1-6 inch, average 1-8.

Leaves: per culm 4; length 3 1-2 to 12 1-2 inches, average 9; width of upper leaf 3-16 to 1-2 inch, average 5-16; lower leaf 1-10 to 1-4 inch, average 1-8.

Panicle: average length 3 — inches; thickness 3-8 to 7-16 inch, average 3-8; breadth 1-4 to 5-16 inch, average 1-4; spikelets per panicle average 20; grains per spikelet 2 to 3; average 2.

TRITICUM MONOCOCCUM, L.

The panicle of this variety is very compact, and the spikelets overlie one another like the shingles of a roof, in two rows, one on each side the rachis. The spikelets are supposed to be one-seeded, but they very commonly contain more than that number. The flowering glumes are awned and the beards are quite stiff though very fine and slender, and lie close along the panicle, a row on each side. The grain is enclosed in the glume, and is not released on thrashing. The seeds are shuttle form. This species tillers very greatly, more than any of the others. It is remarkably free from disease. It is cultivated in some parts of Germany, in Hungary, and Russia. It was introduced from Spain into France in 1850.[1]

1. ENGRAIN COMMUN, VIL.

Synonym: *One Rowed Wheat.*

Culms hollow, harsh, thick, very stiff and erect and generally having a slight crook just below the panicle: nodes white and hairy: foliage very dark green and harsh to the touch: Panicles bearded, light bronze, glabrous, very compact, tapering from base to tip, perfectly erect on the culm, not glaucous: Grain medium light amber, small to medium, flattish, triangular or shuttle form, pointed at both ends: A spring variety.

Culm: average height 3 feet, tallest plant 3 feet 7 1-2 inches; diameter 1-8 to 1-6 inch, average 1-7.

Leaves: per culm 3 or 4, usually 3; length 4 1-4 to 9 3-4 inches, average 6 1-2; width of upper leaf 1-4 to 1-2 inch, average 3-8; lower 1-10 to 3-8 inch, average 3-16.

Panicle: average length 4 1-4 + inches; thickness 1-4 to 5-16 inch; breadth 3-16 inch, almost always; spikelets per panicle average 38; grains per spikelet 1.

2. ENGRAIN DOUBLE, VIL.

Synonym: *Two-Rowed Wheat.*

Culms stout, but slender, and frequently reclining: hollow, thick, harsh to the touch: nodes white and hairy: not glaucous: usually slightly curved at the base of panicle: Panicle bearded, very light bronze, glabrous, harsh, very compact, tapering: Grain light amber, medium large, plump, rather triangular, pointed at the ends: A spring variety.

Culm: average height 3 feet, tallest plant 3 feet 8 inches; diameter 1-6 to 1-7 inch, average 1-9.

Leaves: per culm 4; length 2 1-2 to 7 3-4 inches, average 5 1-2; width of upper leaf 3-16 to 1-2 inch, average 5-16; lower 1-8 to 3-8 inch, average 3-16.

Panicle: average length 3 + inches; thickness 3-8 to 7-16 inch, average 7-16; breadth almost always 1-4 inch; spikelets per panicle average 26; grains per spikelet 2.

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[1] Les Plantes Alimentaires, Heuzé, 1872 t. 1, p. 134.

OAT CLASSIFICATION.

The following classification consists of a revision of that in the Station report for 1884. The changes made are not very great, but many new varieties have been added, others reduced to synonyms, and the number of species increased to three.

A few explanatory remarks will be pertinent here regarding the relation existing between this and the 1884 classification. Alexander's No. 2 oat, sent to the Station by Mr. Alexander under that number, has been christened by himself, "American Beauty," which name is substituted for "No. 2." Challenge has been placed in the class under short berries, and White Champion as synonymous with White Eureka. White Probsteier has been classed as synonymous with Probsteier, and Yellow or Golden Prize with Golden Flanders. American Triumph was in error placed under Sub-species (b), but has been changed to (a). New Australian has been located with White Australian, as a synonym. Mold's Ennobled is no longer a synonym, but a variety by itself, while Mammoth Russian is classed with Rust Proof as a synonym of it. White Novelty and White Zealand have not shown themselves distinctive enough from White Russian to hold the place of separate varieties, and so have been classed as synonyms of the latter.

It is to be noted that several varieties are termed winter oats. In the more Southern States, where the winters are not severe, some varieties of oats can be planted late in the fall, and live through the winter; the first foliage lying close to the surface of the ground, and being fine and grass like in appearance. In the Northern States we have no winter oats.

The term peduncle, refers to the small branches of the head or panicle; glaucous means covered with a bluish coat or bloom; spikelets, the cluster consisting of two or three seeds, and the chaff (termed glume) which encloses them, borne on little stems, or pedicels.

The following persons have kindly sent the Station seeds of varieties, for the favor of which credit is given after each variety, in abbreviations, as is explained and shown after each of the following names: O. H. Alexander, Charlotte, Vt., Alex.; Department of Agriculture, Washington, D. C., Dep't of Ag'l.; J. J. H. Gregory, Marblehead, Mass., Greg.; Prof. F. A. Gulley, Starkville, Miss., Gul.; Peter Henderson, N. Y. City, Hend.; Johnson & Co., Atlanta, Georgia, John.; Johnson & Stokes, Phil., Pa., J. & S.; D. Landreth & Sons, Phil., Pa., Land.; Ohio Experiment Station, Columbus, Ohio., O. E. S.; Pringle & Horsford, Charlotte, Vt., P. & H.; Hiram Sibley & Co., Rochester, N. Y., Sib.; S. A. Taylor, Fitzwilliam Depot, N. H., Tay.; J. M. Thorburn & Co., N. Y. City, Thorb.

SYNOPSIS.

Oats	*Avena Sativa*, L. 2-3 flowered. Empty glumes completely enclosing flowers until maturity. Pedicels of flowering glumes short. Flowering glume remaining on berry.	Open panicle.	Yellowish-white.	Berry long.	American Beauty Danish Early Dakota Georgian Golden Monarch Probsteier Pringle's Progress Seizure Surprise Virginia Winter Washington White Eureka White Schoenen Yellow Flanders
				Berry short.	American Triumph Board of Trade Challenge Gold Foil Hopetoun Welsh White Australian White Victoria
			Black	Berry long.	Black Champion Rousse Couronne Zonette
			Dun	Berry long.	Harris Rust Proof
		Closed panicle	Black	Berry long.	Black Tartarian Mold's Ennobled Bk
			Yellowish white.	Berry long.	White Russian
				Berry short.	Egyptian
	Avena nuda, L. 4-5 flowered. Empty glume very large. Seed falling from flowering glume at maturity.	Open panicle	Yellowish-white.	Berry small, naked.	Chinese Hulless
	Avena brevis, Roth. 2 flowered. Fowering glumes awn'd. Blk'sh dun color.	Semi-open panicle.	Blackish-dun.	Berry short, small.	Flyfoot

OAT. (*Avena.*)

Species 1. *Avena sativa*, L. Spikelets from two to three flowered and completely enclosed by the empty glumes until maturity. Flowering glumes strong and tough, becoming hard, and tightly enclosing the seed; rounded on the back, and usually awned at or near the center, the awns being generally longer than the glume. Flowers attached to one another by short, stout peduncles.

Sub-species (a). Panicle open at maturity, the secondary branches being equally spreading on all sides from the rachis.

† Color of berry whitish-yellow.

* Berry long and taper pointed.

1. AMERICAN BEAUTY, ALEX.

Synonym: *Alexander's No. 2.*

Early foliage medium to dark green, abundant, coarse: Stools profusely: Leaf sheaths slightly loose: Culms medium to large, erect and stout: Panicles open, large, coarse: Grain large, long, tapering, fairly plump, whitish-yellow: base of seed rarely capped with hairs; frequently awned: Thrashes well.

Culm: average height 3 feet 3 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves : per culm 4 to 5 ; length of top leaf 4 1-2 to 10 1-2 inches, average 7 1-2 ; second leaf attains 15 inches, average 13 ; width of upper leaf 3-8 to 7-8 inch, average 5-8 ; lower 1-4 to 1-2 inch, average 3-8.

Panicle : peduncles 7 to 8, average 7 ; spikelets 2 to 3 seeded.

Mr. O. H. Alexander claims this variety to be a cross of his of the Excelsior on the Probsteier.

2. DANISH, TAY.

Early foliage dark green, of medium size, abundant: Stools fair: Sheaths of leaves slightly loose: Culms of good size, but soft and reclining at maturity: Panicles open, of medium size: Grain whitish-yellow, of medium size, long, tapering, broad backed; only slightly hairy at the base; frequently awned: Thrashes very well.

Culm : average height 4 feet, tallest plant 5 feet 1 inch ; diameter 1-8 to 3-10 inch, average 1-6.

Leaves : per culm 4 to 5, average 5 ; length of top leaf 3 1-2 to 14 inches, average 7 1-2 ; second leaf attains 18 1-2 inches, averaging 14 ; width of upper leaf 3-8 to 1 1-15 inch, average 3-4 ; lower 5-16 to 11-16 inch, average 7-16.

Panicle : average length 10 1-2 inches ; peduncles 6 to 9, average 7 ; spikelets 2 seeded.

3. EARLY DAKOTA, O. E. S.

Early foliage dark green, of medium size, very abundant: Stools fair: Culms of good size, but soft and weak, usually breaking over at maturity: Panicles open, rather delicate, medium to large: Grain whitish-yellow, medium size, long, slender, slightly awned, sometimes hairy capped at base, hairs averaging about 1-8 inch long: Late foliage and panicle light green: Leaf sheaths closely clasping: Thrashes well.

Culm: average height 3 feet 10 inches, tallest plant 5 feet 1 inch; diameter 1-7 to 3-10 inch, average 1-6.

Leaves: per culm 4 to 5, average 4; length of top leaf 5 to 14 1-2 inches, average 8 1-2; second leaf attains 18 1-2 inches, average 15; width of upper leaf 7-16 to 1 3-16 inch, average 3 4; lower 1-4 to 1-2 inch, average 3-8.

Panicle: average length 13 inches; peduncles 5 to 7, average 6; grains per spikelet 2 to 3, average 2.

4. GEORGIAN, P. & H.

Early foliage medium to dark green, very fine, profuse, closely decumbent: Stools profusely: Culms of medium size, fairly stout but inclined to be weak: Leaf sheaths tightly clasping: Panicles open, medium stout: Grain whitish-yellow, small, slender, tapering, long, frequently awned: Mature foliage and panicle medium to dark green: Thrashes easily: This is what is termed in some regions a winter oat.

Culm: average height 3 feet 9 inches, tallest plant 4 feet 7 1-2 inches; diameter 1-8 to 1-5 inch, average 1-6.

Leaves: per culm 4 to 6, average 5; length of top leaf 5 to 14 3-4 inches, average 11; second leaf attains 19 inches, average 12; width of upper leaf 3-8 to 11-16 inch, average 1-2; lower 3-10 to 1-2 inch, average 3-8.

Panicle: average length 12 inches; peduncles 5 to 8, average 8; grains per spikelet 2 to 3, average 2.

5. GOLDEN.

Early foliage dark green, medium size, very profuse: Strongly stooled; Culms medium large, strong and erect: Leaf sheaths fairly tight: Panicles open, of medium and regular size: Grain of fair size, long, rather slender, tapering; pale yellow, rarely awned, base not often hairy capped: Thrashes very easily.

Culm: average height 3 feet 3 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4 to 5, average 5; length of top leaf 5 1-4 to 12 1-2 inches, average 7 1-2; second leaf attains 16 inches, average 12 1-2; width of upper leaf 3-8 to 13-16 inch, average 9-16; lower 1-4 to 1-2 inch, average 5-16.

Panicle: average length 7 inches; peduncles 6 to 7, average 6; average grains per spikelet 2.

6. MONARCH, O. E. S.

Early foliage dark green, medium to coarse, quite profuse: Stools well: Culms of good size, fairly erect: Leaf sheaths loosely clasping: Panicles open, dark green, medium size: Grain whitish-yellow, fair size, plump, long, tapering, frequently awned, base rarely hairy capped: Thrashes well; late foliage dark green, and very glaucous.

Culm: average height 3 feet 9 inch, tallest plant 4 feet 9 inches; diameter 1-8 to 1-4 inch, average 1-5.

Leaves: per culm 5 to 6, average 6; average length of top leaf 6 inches; second leaf attains 15 inches, average 13; width of upper leaf 1-2 to 1 inch, average 3-4; lower 3-16 to 9-16 inch, average 1-4.

Panicles: average length 10 inches; peduncles 6 to 8, average 7; grains per spikelet 2 to 3, average 2.

7. PROBSTEIER, GREG.

Synonym: *White Probsteier.*

Early foliage dark green, medium to coarse, fairly profuse: Stools medium: Culms very erect, medium stout: Sheaths tightly clasping as a rule: Panicles open, large and long: Grain whitish-yellow, medium size, long, tapering, frequently awned, base rarely hairy capped: Thrashes very well.

Culm: average height 3 feet 3 inches; diameter 1-8 to 1-5 inch, average 1-6.

Leaves: per culm 5 to 6, average 5; length of top leaf 4 1-2 to 14 1-2 inches, average 9 1-2; second leaf attains 17 inches, average 14; width of upper leaf 3-8 to 1 1-16 inch, average 3-4; lower 3-8 to 5-8 inch, average 7-16.

Panicle: average length 8 inches; peduncles 6 to 8, average 7; grains per spikelet 2 to 3, average 3.

According to Werner[1], this variety is native to Probstei in Holstein.

8. PRINGLE'S PROGRESS, P. & H.

Early foliage dark green, medium to coarse, not profuse: stools sparingly: Culms of medium size, weak, inclined to lodge: Sheaths clasping moderately tight: Panicles open, medium size: Grain pale yellow, large, long, tapering, slightly awned: Glumes very thin and soft: Thrashes fairly well: Late foliage medium dark green, panicles light green.

Culm: average height 3 feet 2 inches, tallest plant 4 feet; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4; length of top leaf 2 3-4 to 11 1-2 inches, average 7; second leaf attains 14 1-4 inches, average 11; width of upper leaf 3-8 to 15-16 inch, average 5-8; lower attaining 9-16 inch, average 5-16.

Panicle: average length 10 1-2 inches; peduncles 4 to 7, average 6; average grains per spikelet 2.

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[1] Handbuch des Getreidebaues, 1885, Band II, p. 682.

9. SEIZURE, SIB.

Early foliage dark green, sparse to profuse: Stools fairly: Culms stout and erect: Sheaths tightly clasping: Panicles open, large, long: Grain whitish-yellow, medium size, long, tapering, fairly plump, usually awned, rarely hairy capped at base: Thrashes easily.

Culm: average height 3 feet 6 inches: diameter 1-8 to 3-10 inch.

Leaves: per culm 4 to 6, average 5; length of top leaf 3 1-2 to 10 1-2 inches, average 7; second leaf attains 17 1-2 inches, average 12; width of upper leaf 7-16 to 1 inch, average 11-16; lower 3-16 to 1-2 inch, average 5-16.

Panicle: average length 8 inches; peduncles 7 to 9, average 8; grains per spikelet 2.

10. SURPRISE, LAND.

Early foliage dark green, medium to coarse, profuse: Stools medium: Culms of good size, fairly stout, but often inclined to one side; upper node is noticeably hairy on the upper and lower sides, passing around the culm: Sheaths closely clasping: Panicles open, delicate, large: Grains medium to large, long, tapering, fairly plump, often awned: Thrashes medium well: Late foliage light green.

Culm: average height 4 feet 4 inches, tallest plant 5 feet 2 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm average 5; average length of top leaf 9 inches; second leaf attains 18 1-4 inches, average 13; width of upper leaf 3-8 to 1 inch, average 11-16; lower 3-16 to 5-8 inch, average 1-4.

Panicle: average length 13 inches; peduncles average 7; average grains per spikelet 2.

C. H. Van Olinda, of Sandwich, DeKalb Co., Ill., introduced, in the vicinity of 1865, an oat under this name[1]. The plant from which this variety originated came up among many oats, the seed of which was received from the U. S. Patent office. This variety has had a wide distribution.

11. VIRGINIA WINTER, LAND.

Synonyms: *Grazing*, John.; *White Winter*, J. & S.

Early foliage light green, grassy, quite profuse, very decumbent: Stools very profuse: Culms small, slender, soft, very weak and always recline before maturity: Sheaths very closely clasping and quite wooly on edges: Panicles open, delicate and slender, not very heavily seeded: Grains small, long, slender, tapering, very pale whitish-yellow, frequently awned, base of grain rarely hairy capped: A winter oat.

Culm: average height 4 feet 3 inches, tallest plant 5 feet; diameter 1-8 to 1-5 inch, average 1-7.

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[1] Moore's Rural New Yorker, Vol. XXI, pp. 298-336-378.

Leaves: per culm 4 to 6, average 5; length of top leaf 3 1-2 to 9 1-2 inches, average 7; second leaf attains 14 1-2 inches, average 12 inches; width of upper leaf 3-8 to 3-4 inch, average 1-2; lower 3-16 to 1-2 inch, average 5-16.

Panicle: average length 12 inches; peduncles 6 to 9, average 7; grains per spikelet average 2.

12. WASHINGTON.

Early foliage medium green, medium to coarse, sparse: Stools sparingly: Culms erect till near maturity when weakness develops; Sheaths tight or slightly loose: Panicle large, weak: Grain whitish-yellow, medium size, long, tapering, occasionally awned, rarely hairy at base: Thrashes well.

Culm: average height 3 feet 3 inches; diameter 1-8 to 3-10 inch, average 1-5.

Leaves: per culm 4 to 5, average 5; length of top leaf 5 1-2 to 13 inches, average 9 1-2; second leaf attaining 17 inches, average 13 1-2; width of upper leaf 3-8 to 1 inch, average 11-16; lower leaf 1-4 to 1-2 inch, average 3-8.

Panicle: average length 8 inches; peduncles 6 to 8, average 7; grains per spikelet average 2.

Said to have come from Washington Territory, and sent out by the U. S. Dep't of Agriculture.

13. WHITE EUREKA, SIB.

Synonyms: *White Champion; White German*, O. E. S.

Early foliage dark green, of medium size, very profuse: Stools abundantly: Culms usually erect, slender; sheaths tight to loose: Panicle open, of good size, fairly stout: Grain medium to large, long, tapering, broad-backed, pale yellow, or whitish-yellow, quite awned, base slightly hairy capped: Thrashes well.

Culm: average height 3 feet 3 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4 to 6, average 5; length of top leaf 5 to 12 inches, average 7 1-2; second leaf attains 16 1-2 inches, average 13 1-2; width of upper leaf 7-16 to 1 inch, average 3-4; lower 1-4 to 9-16 inch, average 7-16.

Panicle: average length 8 inches; peduncles 6 to 8, average 7; grains per spikelet average 2, the larger sometimes being enclosed in the suture of the flowering glume of smaller.

Introduced by A. H. Goddard, Fort Atkinson, Iowa, and originally from Germany, having been brought to Iowa by German immigrants.

14. WHITE SCHOENEN.

Early foliage dark green, medium to coarse, quite abundant: Stools fair: Culms erect or decumbent, and not very stout; nodes usually slightly hairy: Panicles open, medium size, dark green: Grain whitish-yellow, medium to large, long, tapering, occasionally awned, base rarely hairy capped: Thrashes very easily.

Culm: average height 3 feet 3 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4 to 5, average 5; length of top leaf 5 1-2 to 13 inches, average 9; second leaf attains 15 1-2 inches, average 12; width of upper leaf 3-8 to 15-16 inch, average 5-8; lower 1-4 to 1-2 inch, average 3-8.

Panicle: average length 8 inches; peduncles 5 to 8, average 7; grains per spikelet 2 to 3, average 2.

Imported from Germany in 1868 by the U. S. Dep't of Agriculture.

15. YELLOW FLANDERS, P. & H.

Synonym: *Yellow or Golden Prize.*

Early foliage dark green, coarse, fairly profuse: Stools very well: Culms medium to large, fairly stout though often leaning; sheaths fairly tight clasping: Panicles open, well seeded, large, medium dark green: Grain whitish-yellow, long, tapering, large, plump, broad backed, usually awned, base rarely capped with hair: Thrashes easily.

Culm: average height 3 feet 10 inches, tallest plant 4 feet 10 1-2 inches; diameter 1-8 to 1-4 inch, average 1-5.

Leaves: per culm 4 to 6, average 5; length of top leaf 3 to 10 inches, average 7; second leaf attains 16 1-2 inches, average 13 1-2; width of upper leaf 7-16 to 1 inch, average 11-16; lower 1-4 to 5-8 inch, average 7-16.

Panicle: average length 10 1-2 inches; peduncles 6 to 8, average 7; grains per spikelet 2 to 3, average 2.

** Berry short, plump, abruptly pointed.

16. AMERICAN TRIUMPH, GREG.

Synonym: *Triumph*, Thorb.

Early foliage medium light green, very abundant, coarse: Stools very well: Culms of good size, stiff, erect; sheaths loose: Panicle very large, open, stout, many seeded, medium light green: Grain whitish-yellow, medium to large, plump, usually abruptly pointed, frequently awned: Thrashes well.

This variety presents two striking characteristics, viz: the leaves are very long and abundant, and the panicles seem to be much given to smutting. In height it exceeds any open panicle variety grown at the station.

Culm: average height 4 feet 10 inches, tallest plant 5 feet 5 inches; diameter 1-6 to 1-3 inch, average 1-4.

Leaves: per culm 5 to 6, average 5; length of top leaf 7 to 16 inches, average 12; second leaf attains 20 inches, average 17; width of upper leaf 9-16 to 1 1-4 inch, average 1; lower 1-4 to 9-16 inch, average 7-16.

Panicle: average length 15 inches; peduncles 7 to 9; average 8; grains per spikelet average 2, the larger often enclosing the smaller in its flowering glume.

Claimed by C. G. Pringle, Charlotte, Vt., to be a cross of his, of the pollen of the Excelsior, on the Waterloo as female. Introduced by B. K. Bliss & Sons, N. Y. City.

17. BOARD OF TRADE, SIB.

Early foliage medium green, abundant, medium to coarse: Stools fairly: Culms erect, and strong until maturity; sheaths loose: Panicle open, of good size: Grain whitish-yellow, medium size, plump, short, abruptly pointed, very slightly awned, hairy capped at base, smaller often enclosed in flowering glume of the larger: Thrashes well.

Culm: average height 3 feet 6 inches.

Leaves: per culm 4 to 6, average 5; length of top leaf 4 1-2 to 14 3-4 inches, average 8; second leaf attains 17 1-2 inches, average 13; width of upper leaf 3-8 to 15-16 inch, average 5-8; lower 3-16 to 1-2 inch, average 1-4.

Panicle: average length 9 inches; peduncles number 7; grains per spikelet 2, often apparently one, owing to the smaller being enveloped by the larger.

18. CHALLENGE, P. & H.

Early foliage medium to dark green, very coarse, abundant: Stools fairly: Culms very erect, large, but weakly: Sheaths loose: Panicles open, large: Grain whitish-yellow, plump, short, abruptly pointed, frequently awned, base rarely capped with hair: Thrashes easily.

Culm: average height 3 feet 6 inches; diameter 1-7 to 1-3 inch, average 1-4.

Leaves: per culm 4 to 6, average 5; length of top leaf 6 to 12 inches, average 9; second leaf attains 17 1-2 inches, average 14 1-2; width of upper leaf 3-8 to 1 inch, average 3-4; lower 1-4 to 9-16 inch, average 3-8.

Panicle: average length 9 inches; peduncles 7 to 9, average 8; grains per spikelet 2, often apparently but one, the larger enclosing most of the smaller in its suture.

19. GOLD FOIL, P. & H.

Early foliage dark green, not very profuse, of medium size: Stools little: Culms very straight and large, but very long and given to reclining to one side: Sheaths tightly clasping: Panicle open, narrow, long, dark green: Grain whitish-yellow, small, short, abruptly pointed, awnless, heavy: Thrashes very hard.

Culm: average height 4 feet 8 inches; tallest plant 5 feet 5 inches; diameter 1-7 to 1-4 inch, average 1-5.

Leaves: per culm average 5; length of top leaf 4 to 10 inches, average 7 ; second leaf attains 15 1-4 inches, average 12 1-2 ; width of upper leaf 1-2 to 7-8 inch, average 11-16; lower 1-4 to 5-8 inch, average 3-8.

Panicle : average length 11 1-2 inches ; peduncles 7 to 8 ; grains per spikelet 2.

20. HOPETOUN, HEND.

Early foliage dark green, medium size, fairly profuse: Stools well: Culms large, stout, usually erect: Sheaths varying from tight to loose: Panicles open, large, long, dark green: Grain whitish-yellow, small, short, plump, abruptly pointed, usually awned, base rarely hairy: Thrashes fairly well.

Culm: average height 4 feet 4 inches; tallest plant 5 feet 3 1-2 inches ; diameter 1-7 to 3-10 inch, average 3-6.

Leaves: per culm 5 to 6, average 5 ; length of top leaf 5 to 12 inches, average 8 1-2 ; second leaf attains 16 1-2 inches, average 13 ; width of upper leaf 1-2 to 1 1-8 inch, average 7-8 ; lower 1-4 to 5-8 inch, average 3-8.

Panicle: average length 13 inches ; peduncles 8 to 10, average 9; grains per spikelet 2.

Was first grown by Mr. Patrick Sheriff,[1] Mungoswell, East Lothian, England, in 1824, and was introduced to general cultivation in 1830.

[1] Handbuch des Getreidebaues, 1885, Band II, p. 690.

21. WELSH, O. E. S.

Early foliage dark green, medium size, profuse: Stools fairly: Culms large but weakly: Panicles open, large, long, stout, dark green: Grain whitish-yellow, medium size, plump, short, abruptly pointed, frequently awned, base rarely hairy capped: Thrashes easily.

Culm: average height 4 feet, tallest plant 4 feet 11 inches; diameter 1-7 to 1-4 inch, average 1-5.

Leaves: per culm 5 to 6, average 5; top leaf averages 7 1-2 inches long ; second leaf attains 15 1-4 inches, average 13 ; width of upper leaf 1-2 to 1 inch, average 3-4 ; lower 1-4 to 5-8 inch, average 3-8.

Panicle : average length 10 inches ; peduncles average 7; grains per spikelet 2 to 3, average 2.

22. WHITE AUSTRALIAN, SIB.

Synonyms : *Badger Queen*, P. & H. ; *Barley*, O. E. S.; *Canadian*, P. & H.; *Clydesdale*, Hend.; *Early Prize Cluster*, O. E. S. ; *Hallett's Pedigree White Canadian ; Longfellow*, P. & H.; *New Australian ; Prize Chester; Race-Horse*, Greg.; *Welcome*, Sib.; *White Belgian*, Greg.; *White Canadian*, O. E. S.

Early foliage medium green, coarse, fairly profuse: Stools medium: Culms of large size, weak, and usually reclining or lodging before or at maturity: Sheaths loose: Panicle open, large, coarse, long, weak, light green: Grain whitish-yellow, very short and plump, abruptly pointed, frequently awned, base sometimes slightly hairy capped: Thrashes very easily.

Culm: average height 3 feet 10 inches; diameter 1-7 to 3-10 inch, average 1-4.

Leaves: per culm 4 to 5, average 4; length of top leaf 6 to 11 inches, average 8 1-2; second leaf attains 16 inches, average 14; width of upper leaf 9-16 to 1 3-16 inch, average 1 1-16; lower 3-16 to 5-8 inch, average 1-2.

Panicle: average length 9 inches; peduncles 7 to 9, average 8; grains per spikelet 2, usually appearing as one, the larger enclosing smaller in its suture formed by flowering glume.

23. WHITE VICTORIA, DEP'T AGL.

Early foliage light green, sparse, medium size: Stools poorly: Culms of medium size, fairly stout, usually erect; sheaths slightly loose: Panicle open, large, long, stout, well seeded: Grain of medium size, very plump, short, abruptly pointed, whitish-yellow, frequently awned, short hairs usually capping the base: Thrashes easily.

Culm: average height 3 feet 6 inches, tallest plant 4 feet 8 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4 to 5, average 4; length of top leaf, 5 to 10 inches, average 7; second leaf attains 15 1-2 inches, average 11 1-2; width of upper leaf 3-8 to 1 inch, average 3-4; lower 5-16 to 5-8 inch, average 7-16.

Panicle: average length 12 inches; peduncles 5 to 8, average 7; grains per spikelet 2, larger seed often enfolding smaller.

Distributed in 1886 by the U. S. Department of Agriculture, and stated to have been imported from Russia.

†† Color of berry black.

24. BLACK CHAMPION, P. & H.

Early foliage dark green, fine, profuse: Stools well: Culms strong and erect; sheath tight or slightly loose: Panicles open, rather delicate, long: Grains of medium size, fairly plump, generally abruptly pointed; dark black-brown, excepting the tip which is scarious and whitish; usually awned; base of grain capped with delicate hairs about 1-8 inch long, and sometimes white hairs are on the body of the grain: Thrashes hard.

Culm: average height 3 feet 3 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 5 to 6, average 5; length of top leaf 3 to 11 inches, average 7 1-2; second leaf attains 15 1-2 inches, average 13; width of upper leaf 3-8 to 7-8 inch, average 11-16; lower 1-4 to 1-2 inch, average 5-16.

Panicle: average length 10 inches; peduncles 6 to 8, average 7; average grains per spikelet 2.

Imported from France by F. H. Horsford, Charlotte, Vt., several years ago, where it is known under the name of Black Brie Oat (*Noire de Brie*).

25. ROUSSE COURONNE, P. & H.

Early foliage dark green, medium size, rather abundant: Stools fairly: Culms of good size, but not very strong, and usually reclining; sheaths fairly tight: Panicles open, rather narrow, long, dark green: Grain of medium size, long, tapering, frequently awned, dirty brownish-black on the lower two-thirds, the tip third being whitish; many grains dark dun color: Thrashes fairly well: This variety has a very profuse dark green foliage.

Culm: average height 3 feet 9 inches, tallest plant 4 feet 10 inches; diameter 1-7 to 1-4 inch, average 1-6.

Leaves: per culm 6; average length of top leaf 9 inches; second leaf attains 16 1-4 inches, average 12; width of upper leaf 1-2 to 1 inch, average 3-4; lower 1-8 to 3-8 inch, average 1-4.

Panicle: average length 10 inches; peduncles average 7; grains per spikelet 2.

26. ZONETTE, P. & H.

Synonym: *Grey Houdan*, P. &. H.

Early foliage light green, medium to small, very profuse: Stools greatly: Culms quite stiff, strong, slender and erect; sheaths tightly clasping: Panicles open, rather delicate, not heavily seeded, light green: Grain of medium size, long, tapering, fairly plump, deep black-brown, excepting at the very tip, which is a dirty white; slightly awned, base frequently hairy capped: Thrashes easily: A winter oat.

Culm: average height 3 feet, tallest plant 4 feet 1 inch; diameter 1-10 to 1-6 inch, average 1-7.

Leaves: per culm 4 to 5, average 4; length of top leaf 5 to 10 1-2 inches, average 7 1-2; second leaf attains 13 1-2 inches, average 10 1-2; width of upper leaf 3-16 to 11-16 inch, average 7-16; lower 1-8 to 7-16 inch, average 5-16.

Panicle: average length 9 inches; peduncles 6 to 8, average 7; grains per spikelet average 2.

††† Berry dun color.

27. HARRIS, DEP'T AG'L.

Synonym: *Burt's Extra Early Rust Proof*, John.

Early foliage medium light green, fine, profuse, very matted: Stools well: Culms not very stout, short, somewhat weak: Panicle open, small, short, quite constant in length: Grain ashy yellow or dun color, very long, slender, tapering, gray tipped, base slightly hairy capped, awned: Thrashes easily: This is a so-called rust proof oat, and is also known as a winter oat.

Culm: average height 2 feet 10 inches, tallest plant 3 feet 9 inches; diameter 1-16 to 1-5 inch, average 1-8.

Leaves: per culm 4; length of upper leaf 2 to 13 1-2 inches, average 7 1-2; average length of lower leaf 9 inches; width of upper leaf 1-8 to 3-8 inch, average 1-4; lower 1-4 to 1-2 inch, average 5-16.

Panicle: average length 6 1-2 inches; grains per spikelets 2 to 3, average 3.

This variety was distributed by the U. S. Department of Agriculture, in the spring of 1886, and is said to have come from Alabama.

28. RUST PROOF, O. E. S.

Synonyms: *Georgia Red Rust Proof*, John.; *Mammoth Russian*; *Milliard's Kansas Hybrid*, O. E. S.; *Red Rust Proof*, Gul.

Early foliage light green, fine almost to grassiness, usually profuse, very matted: Stools strikingly: Culms small to medium, fairly strong; sheaths closely clasping: Panicles open, small, dark green: Grain light dun or whitish-brown, large, plump, broad backed, tapering, long, usually awned, tip grayish and ragged, base capped with delicate hairs which often exceed 1-8 of an inch in length: Thrashes rather hard: A winter oat.

Culm: average height 3 feet 6 inches; tallest plant 4 feet 7 1-2 inches; diameter 1-8 to 1-5 inch, average 1-6.

Leaves: per culm 4 to 5, average 5; average length of top leaf 7 inches; second leaf attains 15 1-2 inches, average 12: width of upper leaf 3-8 to 3-4 inch, average 9-16; lower 3-16 to 1-2 inch, average 1-4.

Panicle: average length 9 inches; peduncles 6 to 7, almost always 6; grains per spikelet 2 to 3, often the latter.

Sub-species (b). Panicle closed or but slightly open at maturity, the peduncles being erect along the rachis of the panicles, with the general tendency towards one side.

+Color of berry black.

‡Berry long and tapering.

29. BLACK TARTARIAN, P. & H.

Synonym: *Black Hungarian*, P. & H.

Early foliage medium to dark green, profuse, medium to coarse: Stools very well: Culms stiff, erect and stout; sheaths somewhat loose: Panicles compact, erect, long, turned to one side, medium dark green: Grain of medium size, deep brown-black for lower two-thirds, and light brownish at the tip, tapering, fairly plump, strongly awned: Thrashes well: Glumes very prominent.

Culm: average height 3 feet 3 inches; diameter 1-7 to 1-3 inch, average 1-4.

Leaves: per culm 5 to 6, average 5; length of top leaf 6 to 13 1-2 inches, avarage 9; second leaf attains 18 inches, average 15; width of upper leaf 7-16 to 1 inch, average 3-4; lower 5-16 to 11-16 inch, average 1-2.

Panicle: average length 9 inches; peduncles 6 to 9, average 8; average grains per spikelet 2.

This variety has been cultivated for many years in the low-lying districts of England and Scotland.

30. MOLD'S ENNOBLED BLACK, THORB.

Early foliage green, of medium size, fairly profuse: Stools rather sparsely: Culms, large, stout and erect; sheaths loose: Panicles turned to one side, compact, heavily seeded, medium dark green: Grain blackish-brown or dark burnt brown for basal half, and balance a dirty brown-yellow; long, tapering, of medium size, much awned: Thrashes very easily: Glumes quite prominent.

Culm: average height 4 feet 2 inches; tallest plant 4 feet 10 inches; diameter 1-7 to 3-10 inch, average 1-4.

Leaves: per culm 5 to 6, average 5; length of top leaf 5 to 12 inches, average 7 1-2; second attains 15 1-2 inches, average 12; width of upper leaf 7-16 to 7-8 inch, average 11-16; lower 5-16 to 5-8 inch, average 7-16.

Panicle: average length 10 inches; peduncles 6 to 8, average 7; grains per spikelet average 2.

This is said to be an improved form of the Black Tartarian.

++Color of berry whitish-yellow.

31. WHITE RUSSIAN, GREG.

Synonyms : *Japan*, Sib.; *White Novelty*, Sib.; *White Russian Improved*, O. E. S.; *White Zealand*, Greg.; *Yankee Prolific*, Ever.

Early foliage medium dark green, fair size, profuse: Stools well: Culms erect, fairly stout; sheaths tight: Panicles turned to one side, compact, long, medium dark green: Grain pale yellow, medium to large, long, taper-pointed, slightly awned: Thrashes well.

Culm : average height 3 feet 6 inches; diameter 1-8 to 1-4 inch, average 1-6.

Leaves: per culm 4 to 6, average 5; length of top leaf 4 1-2 to 11 1-2 inches, average 7 1-2; second leaf attains 19 1-2 inches, average 16; width of upper leaf 7-16 to 1 inch, average 3-4; lower, 5-16 to 5-8 inch, average 1 2.

Panicle: average length 9 1-2 inches; peduncles 6 to 8, average 7; grains per spikelet average 2.

‡‡Berry short and abruptly pointed.

32. EGYPTIAN.

Early foliage dark green, fine to medium, fairly abundant: Stools medium: Culms large, but somewhat soft, and not quite as stout as White Russian: Sheaths loose: Panicles slightly turned to one side, very long and compact, heavily seeded, medium dark green : Grain whitish-yellow, very short, plump, abruptly pointed, rarely awned, sometimes hairy capped at base: Flowering glume of larger, sometimes enclosing small seed in its suture: Thrashes hard.

Culm: average height 4 feet 3 inches, tallest plant 4 feet 9 1-2 inches; diameter 1-7 to 1-3 inch, average 1-4.

Leaves: per culm almost invariably 5; length of top leaf 5 1-2 to 12 inches, average 8 1-2; second leaf attains 18 inches, average 15; width of upper leaf 1-2 to 13-16 inch, average 13-16; lower 3-16 to 9-16 inch, average 3-8.

Panicle: average length 12 inches; peduncles 7 to 8, average 8; grains per spikelet average 2.

Species 2, *Avena nuda*, L. The spikelet contains one or two or more glumes than does *sativa*, and the flowers are more widely separated, as the pedicels of the flowering glumes are more elongated. The empty glumes are longer than those of *sativa*, and at maturity they are unable to hold the flowers, which to a slight extent hang pendent from the glumes by their angled or elbowed pedicels. The berry becomes easily detached at maturity, and falls in a naked condition from the flowering glume. Empty glumes very large. The main axes of the panicles, and peduncles of spikelets, delicate and wiry. Panicle spreading. Color of seed white.

33. CHINESE HULLESS, GREG.

Synonyms: *Bohemian*, O. E. S.; *French Hulless*, P. & H.; *Pringle's Excelsior Hulless; Pringle's Hybridized Hulless*, Sib.

Early foliage medium to light green, medium to coarse, abundant: Stools well: Culms medium stout, erect to maturity, when they are very apt to lodge: Sheaths somewhat loose: Panicles open, large: Spikelets rather loose, pedicels of individual flowering glumes quite long, and the latter not usually awned: Glumes long and very soft and delicate: Grain small, covered with minute hairs, and falls naked from the glume when thrashed: Thrashes hard, and cleans with difficulty.

Culm; average height 2 feet 8 inches; diameter 1-8 to 1-3 inch, average 1-4.

Leaves: per culm 4 to 5, average 4; length of top leaf 4 3-4 to 14 inches, average 9; second leaf attains 17 1-2 inches, average 14; width of upper leaf 3-8 to 15-16 inch, average 11-16; lower 1-4 to 5-8 inch, average 3-8.

Panicle: average length 7 inches; peduncles 7 to 9, average 8; grains per spikelet 2 to 5, average 3.

A very careful study of the different named hulless oats sent to the Station, has convinced me that all are one and the same variety.

This oat has been known for centuries. The Chinese, in writings dating back to the seventh century, refer to a hulless oat. Gerarde,[1] in 1597, writes of naked oats grown in England that "immediately as they be thrashed without helpe of a mill become Ote meale fit for our use."

Species 3, *Avena brevis*, Roth. Spikelets almost invariably two-flowered. Flowering glumes furnished with long stiff, knee jointed awns, possessing hygroscopic properties of moving under the influence of heat and moisture. Grain stout, united by a slender pedicel. Panicle small and slightly turned to one side.

34. FLY-FOOT, P. & H.

Synonyms: *Short; Pied de Mouche* (French for Fly-foot).

Early foliage light green, fine, profuse: Stools fairly: Culms slender, rye-like, not very stout, long, erect till near maturity, when they appear weak and often fall; sheaths very tight: Leaves narrow: Panicles partly to one side, narrow, small: Grain of peculiar grayish or slatish-black color, small, slender, tapering, short awned: Flowering glume often crowned on the parts about the awn, with short delicate hairs: Late foliage and panicle light green: Thrashes fairly easy, and many of the awns break off.

Culm: average height 4 feet 6 inches, tallest plant 5 feet 1 1-2 inches; diameter 1-10 to 1-5 inch, average 1-6.

Leaves: per culm 4 to 6, average 5; length of leaf 3 1-2 to 12 3-4 inches, average 8; width of upper leaf 1-4 to 9-16 inch, average 3-8; lower 1-8 to 3-8 inch, average 3-16.

Panicle: average length 8 1-2 inches; peduncles average 7: grains per spikelet 2 to 3, nearly always 2.

This species, of which there is but one variety, is cultivated in the mountainous districts of Europe, as in Auvergne and Forez, where the country people call it *pied de mouche*,[2] or fly's legs. *Avena brevis* is also cultivated in northern Spain.[3] It was supposed to have been first introduced[4] into England from Germany in 1804.

This oat thrives in very poor soil. In France it is sometimes called "Hay oat," being used for fodder.

CEREAL STATISTICS.

The following table gives in alphabetical order the dates of planting, vegetation, panicling, blooming, and ripening of American wheat, oats and barley, and their synonyms. The number of days from the vegetation of grain to ripeness of seed is given, the spring varieties being in one column, the winter in another.

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[1] Gerarde's Herball, London, 1597, p. 68, chap. 48.

[2] Morton's Cpclopædia of Agriculture, 1869, vol. 1, p. 171.

[3] Heuzé. Les Plant Alimen., 1872, p. 514.

[4] Lawson's Agriculturists' Manual, 1836, p. 52.

Number.	WHEAT.	Planted.	Vegetated.	Panicled.	Bloomed.	Ripe.	No. days from vegetation to maturity.	
							Winter wheats.	Spring wheats.
1	Bennett	Sept. 24	Sept. 30	June 10	June 14	July 27	300	
2	Cal. Blue Stem	" 24	" 30	" 10	" 13	" 19	292	
3	Champ. Amber	" 24	" 30	" 7	" 12	" 19	292	
4	Clawson	" 24	" 30	" 7	" 13	" 21	294	
5	Crystal Rock..	Apr. 16	Apr. 24	" 26	July 2	Aug. 9		107
6	Dallas........	" 16	" 24	July 2	" 5	" 14		112
7	Democrat.....	Sept. 24	Sept. 30	June 10	June 14	July 22	295	
8	Early Rice....	" 24	" 30	" 8	" 10	" 19	292	
9	Egypt.(O.E.S.)	" 24	" 30	" 8	" 12	" 20	293	
10	" D'p't.Ag'l	Apr. 16	Apr. 24	" 16	" 24	Aug. 4		102
11	Ex.E'y. Oakley	Sept. 24	Sept. 30	" 3	" 8	July 16	289	
12	Finley	" 24	" 30	" 7	" 12	" 19	292	
13	Fountain . ..	Apr. 16	Apr. 24	" 21	" 27	Aug. 5		103
14	French Imp...	" 16	" 24	" 26	" 29	" 14		112
15	Fultz.........	Sept. 24	Sept. 30	" 7	" 10	July 19	292	
16	Fultzo-Claw...	" 24	" 30	" 8	" 13	" 27	300	
17	Geiger	Apr. 16	Apr. 24	" 17	" 21	Aug. 2		100
18	Ger. Amber...	Sept. 24	Sept. 30	" 5	" 10	July 19	292	
19	Gold Dust....	" 24	" 30	" 5	" 7	" 16	289	
20	Golden Drop..	" 24	" 30	" 3	" 8	" 19	292	
21	Golden Straw.	" 24	" 30	" 7	" 11	" 19	292	
22	Gorham White	" 24	" 30	" 7	" 12	" 27	300	
23	Grecian	" 24	" 30	" 9	" 13	" 22	295	
24	Green Mt. Sp..	Apr. 16	Apr. 24	" 25	" 29	Aug. 9		107
25	Heighe's Prolf.	Sept. 24	Sept. 30	" 7	" 10	July 19	292	
26	Hun. W't. Chaff	" 24	" 30	" 7	" 13	" 20	293	
27	Im. Mediterran	" 24	" 30	" 10	" 13	" 20	293	
28	Lancaster.....	" 24	" 30	" 7	" 10	" 19	292	
29	Landreth	" 24	" 30	" 11	" 14	" 27	300	
30	Martin's Amb.	" 24	" 30	" 7	" 13	" 20	293	
31	McGhee's Red.	" 24	" 30	" 7	" 10	" 20	293	
32	" White	" 24	" 30	" 7	" 9	" 17	290	
33	Mediterranean.	" 24	" 30	" 3	" 8	" 19	292	
34	Mich. Bronze..	" 24	" 30	" 7	" 11	" 19	292	
35	Nonpareil ...	Apr. 16	Apr. 24	" 24	" 28	Aug. 4		102
36	Hybrid Med...	Sept. 24	Sept. 30	" 5	" 11	July 19	292	
37	Mennonite	" 24	" 30	" 7	" 13	" 20	293	
38	Michigan Amb.	" 25	" 30	" 7	" 11	" 20	293	
39	Mil.Gen. Prol'f	" 25	" 30	" 7	" 13	" 21	294	
40	N. Y. Spring..	Apr. 16	Apr. 24	" 24	" 28	Aug. 14		112
41	Nigger	Sept. 25	Sept. 30	" 3	" 9	July 19	292	
42	Poole	" 25	" 30	" 5	" 9	" 19	292	
43	Purple Straw .	Apr. 16	Apr. 24	" 28	July 1	Aug. 14		112
44	Red Amber ...	Sept. 25	Sept. 30	" 5	June 10	July 19	292	
45	Red Fultz	" 25	" 30	" 7	" 11	" 19	292	
46	Red Mediter..	" 25	" 30	" 7	" 11	" 21	294	
47	Red Straw.. .	" 25	" 30	" 10	" 13			
48	Rice	" 25	" 30	" 8	" 13	" 22	295	
49	Rocky Mount.	" 25	" 30	" 7	" 11	" 19	292	
50	Royal Austral.	" 25	" 30	" 7	" 12	" 26	299	
51	Russian May..	" 25	" 30	" 7	" 11	" 19	292	
52	Russian No. 2.	" 25	" 30	" 7	" 12	" 22	295	

Number.	WHEAT.	Planted.	Vegetated.	Panicled.	Bloomed.	Ripe.	No. days from vegetation to maturity.	
							Winter wheat.	Spring wheat.
53	Rust Proof....	Apr. 16	Apr. 24	June 27	June 30	Aug. 9		107
54	Sandomirka..	Sept. 25	Sept. 30	" 9	" 13	July 27	300	
55	Saskatch'n Fife	Apr. 16	Apr. 24	" 23	" 26	Aug. 9		107
56	" Spring	" 16	" 24	" 23	" 26	" 9		107
57	Scotch Fife...	" 16	" 24	" 23	" 26	" 9		107
58	Scott, bearded.	Sept. 25	Sept. 30	" 9	" 13	July 22	295	
59	Scott, beardless	" 25	" 30	" 10	" 13	" 27	300	
60	Silver Chaff...	" 25	" 30	" 13	" 17	" 27	300	
61	Silver Medal..	Apr. 16	Apr. 24	" 21	" 26	" 9		107
62	Smith's Imp'vd	Sept. 25	Sept. 30	" 13	" 16	" 27	300	
63	Surprise......	" 25	" 30	" 10	" 11	" 22	295	
64	Swamp.......	" 25	" 30	" 8	" 13	" 22	295	
65	Tappahannock.	" 25	" 30	" 8	" 13	" 22	295	
66	Tasmanian Red	" 25	" 30	" 8	" 14	" 27	300	
67	Theiss........	" 25	" 30	" 8	" 13	" 22	295	
68	Travis........	" 25	" 30	" 14	" 22	" 30	303	
69	Treadw'll, b'd'd	" 25	" 30	" 14	" 23	" 28	301	
70	Tr'dw'll, b'dl'ss	" 25	" 30	" 10	" 14	" 28	301	
71	Valley	" 25	" 30	" 10	" 15			
72	Velvet Chaff..	" 25	" 30	" 7	" 11	" 22	295	
73	Wash'gt'nGlass	" 25	" 30	" 12	" 16	" 24	297	
74	WayneCo.S'lc't	" 25	" 30	" 10	" 14	" 27	300	
75	White Bl'e St'm	" 25	" 30	" 9	" 14	" 28	301	
76	White Crimean	Apr. 16	Apr. 24	" 16	" 20	Aug. 2		100
77	WhiteEldorado	Sept. 25	Sept. 30	" 7	" 13	July 7	300	
78	WhiteMount'in	" 25	" 30	" 9	" 15	" 29	302	
79	White Rogers..	" 25	" 30	" 12	" 17	" 31	304	
80	White Russian.	Apr. 16	Apr. 24	" 20	" 25	Aug. 9		107
81	White Velvet..	Sept. 25	Sept. 30	" 10	" 14	July 27	300	
82	Yellow B. Stem	" 25	" 30	" 9	" 13	" 27	300	
83	York Wh. Chaff	" 25	" 30	" 9	" 13	" 28	301	
84	Zimmerman...	" 25	" 30	" 10	" 14	" 29	302	

Number.	OATS.	Planted.	Vegetated.	Panicled.	Bloomed.	Ripe.	No. days vegetation to maturity.
1	American Beauty	Apr. 16	Apr. 24	June 23	June 28	Aug. 5	103
2	“ Triumph	“	“	July 2	July 5		
3	Badger Queen	“	“	June 23	June 28	July 28	95
4	Barley	“	“	“ 21	“ 28	“ 28	95
5	Black Champion	“	“	“ 28	“ 30	Aug. 14	112
6	“ Hungarian	“	“	“ 25	“ 30	“ 9	107
7	“ Tartarian	“	“	“ 29	July 5	“ 9	107
8	Board of Trade	“	“	“ 21	June 26	“ 2	100
9	Bohemian	“	“	“ 15	“ 26	July 30	97
10	Burt's Ex. Early Rust Prf.	“	“	“ 12	“ 16	“ 22	89
11	Canadian	“	“	“ 21	“ 28	“ 30	97
12	Challenge	“	“	“ 21	“ 28	“ 28	95
13	Chinese Hulless	“	“	“ 23	“ 28	“ 31	98
14	Clydesdale	“	“	“ 23	“ 28	“ 28	95
15	Danish	“	“	“ 21	“ 26	“ 31	98
16	Early Dakota	“	“	“ 21	“ 26	“ 29	96
17	“ Prize Cluster	“	“	“ 23	“ 26	“ 28	95
18	Egyptian	“	“	“ 28	July 1	Aug. 6	104
19	Fly-foot	“	“	“ 23	June 29	July 30	97
20	French Hulless	“	“	“ 21	“ 28	“ 31	98
21	Georgian	“	“	“ 24	“ 29	Aug. 5	103
22	Georgia Red Rust Proof	“	“	“ 17	“ 28	July 31	98
23	Gold Foil	“	“	“ 25	“ 29	Aug. 5	103
24	Golden	“	“	“ 23	“ 28	July 30	97
25	Gray Houdan	“	“	“ 21	“ 28		
26	Grazing	“	“	“ 24	“ 29	Aug. 14	112
27	Harris	“	“	“ 13	“ 16	July 22	89
28	Hopetoun	“	“	July 1	July 3	Aug. 9	107
29	Japan	“	“	June 28	June 30	“ 9	107
30	Longfellow	“	“	“ 24	“ 28	July 28	95
31	Mammoth Russian	“	“	“ 26	“ 30	Aug. 9	107
32	Milliard's Kansas Hybrid	“	“	“ 16	“ 26	“ 6	104
33	Mold's Ennobled Black	“	“	“ 26	“ 30	“ 6	104
34	Monarch	“	“	“ 21	“ 28	July 31	98
35	New Australian	“	“	“ 24	“ 28	“ 29	96
36	Hallett's Pedi. Wh. Can.	“	“	“ 25	“ 29	“ 31	98
37	Pringle's Excelsior Hulless	“	“	“ 15	“ 25	Aug. 5	103
38	“ Hybridized	“	“	“ 21	“ 26	“ 5	103
39	“ Progress	“	“	“ 16	“ 26	July 28	95
40	Prize Chester	“	“	“ 25	“ 29	Aug. 2	100
41	Probsteier	“	“	“ 24	“ 29	July 30	97
42	Race Horse	“	“	“ 24	“ 29	“ 29	96
43	Red Rust Proof	“	“	“ 16	“ 25	“ 30	97
44	Rousse Couronne	“	“ 25	“ 29	July 2	Aug. 10	107
45	Rust Proof	“	“ 24	“ 17	June 28	July 30	97
46	Seizure	“	“ 24	“ 26	June 29	Aug. 5	103
47	Surprise	“	“ 24	“ 21	July 1	“ 6	104
48	Virginia Winter	“	“ 26	July 6	“ 10	“ 14	110
49	Washington	“	“ 24	June 24	June 29	“ 5	103
50	Welcome	“	“ 24	“ 23	“ 25	July 28	95
51	Welsh	“	“ 24	“ 24	“ 29	Aug. 5	103

Number.	OATS.	Planted.	Vegetated.	Panicled.	Bloomed.	Ripe.	No. days vegetation to maturity.
52	White Australian	Apr. 16	Apr. 24	June 25	June 29	July 28	95
53	White Belgian	“	“	“ 25	“ 28	“ 29	96
54	White Canadian.........	“	“	“ 25	“ 29	“ 31	98
55	White Champion.	“	“	“ 26	“ 29	Aug. 5	103
56	White Eureka.....	“	“	“ 24	“ 28	“ 5	103
57	White German.	“	“	“ 24	“ 28	“ 5	103
58	White Novelty..........	“	“	“ 24	“ 29	“ 14	112
59	White Probsteier.........	“	“	“ 24	“ 29	“ 6	104
60	White Russian...........	“	“	“ 29	July 1	“ 14	112
61	White Russian, Improved.	“	“	“ 25	June 29	“ 11	109
62	White Schoenen.........	“	“	“ 23	“ 28	July 29	96
63	White Victoria...... ...	“	“ 26	“ 28	“ 29	Aug. 6	102
64	White Winter...........	“	“	July 5	July 6	“ 14	112
65	White Zealand.	“	“	June 24	“ 1	“ 11	109
66	Yankee Prolific..........	“	“	“ 23	June 28	“ 9	107
67	Yellow or Golden Prize ..	“	“	“ 21	“ 26	July 29	96
68	Yellow Flanders.........	“	“	“ 23	“ 28	“ 29	96
69	Zonette.................	“	“	“ 21	“ 26	“ 31	98

Number.	BARLEY.	Planted.	Vegetated.	Panicled.	Ripe.	No. days vegetation to maturity.
1	Adam's Heavy...................	Apr. 15	Apr. 22	June 16	July 27	96
2	Black Nepaul...................	“	“	“ 10	“ 28	97
3	Black Hulless..................	“	“		“ 22	91
4	Chevalier......................	“	“	“ 14	“ 21	90
5	Chevalier, Cross-Bred....	“	“		Aug. 4	104
6	Chevalier, Kinver's.............	“	“		“ 5	105
7	Chevalier, Scotch	“	“		“ 5	104
8	Common Two-Rowed....	“	“	“ 16	July 28	97
9	Danish....	“	“		Aug. 4	104
10	Horsford's Bald................	“	“	“ 9	July 22	91
11	Hulless Six Rowed	“	“	“ 9	“ 21	90
12	Hulless Two-Rowed.............	“	“	“ 9	“ 22	91
13	Imperial	“	“	“ 7	Aug. 4	104
14	Manshury	“	“	“ 13	July 22	91
15	Melon	“	“		Aug. 9	109
16	Nepaul	“	“	“ 16	July 22	91
17	Pringle's New Hybrid...	“	“	“ 16	Aug. 4	104
18	Scotch Two-Rowed....	“	“	“ 14	“ 4	104
19	Spring...	“	“	“ 14	July 22	91
20	Sweden Improved	“	“		“ 27	96

TILLERING IN CEREAL GROWTH.

What is termed tillering in some localities, stooling in others, or both, in the same region, is the development of shoots or suckers from the root or base of the culm of the plant. This characteristic is especially striking in the grass family, a cluster of many shoots arising from a common center, at or near the surface of the ground. Among our agricultural plants, barley, oats, rye and wheat are the ones most given to tillering. In these classes of plants are many varieties, possessing certain habits and modes of growth, and having special developments peculiar to themselves as individuals. In tillering is this essentially true and of so great importance does the grain growing farmer consider the tillering in the varieties he wishes to grow, that this feature has great weight with him in the selection of the variety. Other things being equal, if one variety produces five stalks on an average, to another's ten, the latter will prove far more profitable for the farmer to grow. With a view of obtaining comparative figures of the tillering habit in our cereal varieties, barley, oats, rye and wheat were planted under conditions best adapted to this study. Though these conditions were not such as are found in the field, considering that the varieties had equal treatment in every way, the figures resulting have just as great a relative value as they would have had, had the plants been under field culture. The seed was sown in rows two feet apart, each grain being placed six feet apart in the row. The winter wheat varieties, owing to the srverity of winter, suffered from cold, and the plants did not attain the robust development often seen, yet this did not interfere with their completing their growth, tillering well, and producing large, stout heads. The barley, oats and rye were restricted in no way in making a perfect development. The following tables give the number of plants counted of each variety, the one producing the maximum number of shoots, the minimum number, and the average number from all the plants. The varieties are placed in alphabetical order, and in cases where different names are the same variety, a duplicate numeral is used to designate the same. No culms were counted that did not produce a panicle.

No.	BARLEY.	Number of plants.	Maximum tillering.	Minimum tillering.	Average tillering.
1	Adams's Heavy	70	22	3	10.68
2	Black Hulless	65	13	1	6.01
3	" Nepaul	44	26	3	12.52
4	Chevalier	75	23	3	11.33
5	Common Two-Rowed	59	41	6	15.83
6	Cross-bred Chevalier	38	24	3	11.52
7	Danish	43	17	1	8.37
8	Hulless Two-Rowed	43	22	1	10.25
9	" Six "	44	16	3	9.36
10	Horsford's Bald	45	15	1	7.28
11	Imperial	59	14	1	7.30
12	Kniver's Chevalier	41	25	4	11.87
13	Manshury	63	15	1	6.87
14	Melon	43	15	1	8.79
15	Nepaul	24	16	2	8.83
16	Pringle's New Hybrid	51	24	4	10.45
17	Scotch Chevalier	30	39	2	12.33
18	" Two-Rowed	65	25	2	10.96
19	Six-Rowed Black	2	13	10	11.50
20	Spring	46	25	3	8.54
21	Sweden Improved	45	40	3	11.88
22	Two-Rowed Black	23	39	11	24.73
23	Vermont Champion	11	15	4	9.90

Grouping the two and six-rowed into their respective classes, we find that the relationship they bear to one another as to the maximum and minimum and average number of culms per plant, is as follows :

No.			Maximum tillering.	Minimum tillering.	Average tillering.
1	Two-Rowed varieties		28.00	3.63	12.67
2	Six " "		18.00	2.75	8.97

No.	OATS.	Number of plants.	Maximum tillering.	Minimum tillering.	Average tillering.
1	Alexander's No. 2, 18	42	28	3	13.66
2	American Beauty, 18	60	42	3	14.26
3	" Triumph, 23	54	29	2	9.83
4	Badger Queen, 24	43	25	6	11.00
5	Barley, 24	54	41	1	13.66
6	Black Champion	59	45	2	22.55
7	" Hungarian, 28	27	56	9	21.00
8	" Tartarian, 28	50	26	4	12.04
9	Board of Trade	43	62	2	20.95
10	Bohemian, 30	25	30	7	18.56
11	Burt's Extra Early Rust Proof, 26	60	64	9	29.16
12	Canadian, 24	38	37	6	16.84
13	Challenge	54	27	5	11.94
14	Chinese Hulless, 30	12	30	14	21.00
15	Clydesdale 24	67	23	3	10.28
16	Danish	49	24	7	14.59
17	Early Dakota	56	50	2	18.10
18	Early Prize Cluster, 24	50	31	3	12.06
19	Egyptian	61	24	2	11.37
20	Fly Foot	47	42	9	24.25
21	French Hulless, 30	30	58	9	24.23
22	Georgian	54	46	12	24.14
23	Georgia Red Rust Proof, 27	49	71	6	28.20
24	Gold Foil	56	23	5	12.32
25	Golden	61	37	3	15.60
26	Gray Houdan, 25	36	61	11	31.86
27	Grazing, 20	64	58	7	27.18
28	Hallett's Pedigree White Canadian, 24	48	28	4	10.12
29	Harris, 26	52	65	9	38.01
30	Hopetoun	55	34	5	16.43
31	Japan, 29	51	29	6	13.47
32	Longfellow, 24	59	20	3	9.75
33	Mammoth Russian, 27	51	87	17	48.35
34	Milliard's Kansas Hybrid, 27	37	93	16	39.13
35	Mold's Ennobled Black	50	18	3	9.96
36	Monarch	63	35	5	12.34
37	New Australian, 24	47	30	3	10.67
38	Pringle's Excelsior Hulless, 30	31	28	7	15.38
39	Pringle's Hybridized Hulless, 30	29	32	7	15.89
40	Pringle's Progress	51	21	4	12.53
41	Prize Chester, 24	36	22	3	9.80
42	Probsteier, 19	52	30	3	15.26
43	Race Horse, 24	70	18	2	8.01
44	Red Rust Proof, 27	36	90	11	40.05
45	Rousse Couronne	54	46	8	23.20
46	Rust Proof, 27	53	51	12	24.00
47	Schoenen	50	22	3	12.08
48	Seizure	61	36	2	14.27
49	Surprise	49	31	5	15.26
50	Triumph, 23	60	23	4	10.12
51	Virginia Winter, 20	54	64	7	28.46
52	Washington	49	30	2	14.34
53	Welcome, 24	71	23	2	9.11

Number.	OATS.	Number of plants.	Maximum tillering.	Minimum tillering.	Average tillering.
54	Welsh	51	27	6	13.60
55	White Australian, 24	60	21	2	9.51
56	White Belgian, 24	53	23	3	10.26
57	White Canadian, 24	70	32	2	12.52
58	White Champion, 21	52	31	4	13.00
59	White Eureka, 21	60	35	4	12.80
60	White German, 21	60	35	4	13.53
61	White Novelty, 29	66	47	3	16.07
62	White Probsteier, 19	62	36	4	14.03
63	White Russian, 29	65	26	4	14.92
64	White Russian Improved, 29	65	33	4	15.23
65	White Schoenen	63	39	1	13.63
66	White Victoria	59	18	2	8.59
67	" Winter, 20	59	71	3	28.10
68	" Zealand, 29	51	37	7	18.00
69	Zonette, 25	39	135	16	63.84
70	Yankee Prolific, 29	70	23	6	12.95
71	Yellow Flanders, 22	49	30	8	16.30
72	" or Golden Prize, 22	63	23	3	12.46
	Average		39.13	5.43	16.31

Grouping these varieties in their various classes, the following figures are obtained:

No.	GROUPS.	Maximum tillering.	Minimum tillering.	Average tillering.
63	Open panicle	39.95	5.49	16.33
9	Side "	33.44	5	15.00
5	Hulless	35.60	8.80	19.01
67	Hulled	39.55	5.17	15.96
6	Black	66.83	9.16	30.29
66	White or light dun	36.62	5.09	14.89
11	Winter	73.18	10.36	34.41
61	Summer	33.00	4.54	12.88

The above figures relating to the percentage of tillering of the different classes of oats, are both interesting and valuable. From them we learn that the open panicled oat averages more fruitful culms per plant than the side panicle, though the difference is not striking. The hulless oat exceeds the hulled in tillering to a noticeable extent, while the black oats produce over two culms to every one of the white class. The most remarkable variation occurs, however, between the ordinary and so-called winter oat. The latter tillers far more than any of the others, yielding nearly three for every one of the summer oats. The Zonette, a winter variety, produced on one plant 135 culms, each bearing a panicle. It is well to state here, however, that those varieties producing the greatest number of culms, have small panicles, and are not meritorious for northern latitudes.

RYE.

No.	NAME.	Number of plants.	Maximum tillering.	Minimum tillering.	Average tillering.
1	French Spring	25	18	3	8.40
2	Multiplying	20	41	4	20.50
3	Spring	42	18	2	7.57

WHEAT.

No.	NAME.	Number of plants.	Maximum tillering.	Minimum tillering.	Average tillering.
1	Amidonnier blanc	23	58	14	37.26
2	“ roux	3	43	33	38.33
3	Bennett	35	23	4	10.34
4	Belotourka	26	44	4	20.23
5	Blount’s Hybrid No. 15	24	39	11	21.16
6	“ “ “ 17	27	29	5	15.73
7	“ “ “ 28	37	28	4	15.91
8	Bordeaux	27	37	7	18.96
9	California Blue Stem, 2	32	16	2	7.28
10	Champion Amber	27	28	2	11.40
11	Champlain	35	38	2	13.80
12	Clawson, 6	35	31	3	11.20
13	Dallas	25	37	1	14.64
14	Democrat, 4	12	18	3	9.66
15	Early Rice, 17	25	16	2	7.32
16	Egyptian (From Dep’t of Ag’l)	33	28	3	10.30
17	Egyptian (From Ohio Ex. Station) 5	40	16	1	8.50
18	Engrain commun	6	77	18	48.83
19	“ double	18	41	9	18.00
20	Epeautre blanc barbu	20	41	2	22.65
21	“ noir barbu	20	24	5	15.45
22	“ de Tartarie	9	44	23	31.11
23	Extra Early Oakley, 9	14	16	2	7.07

WHEAT.

No.	NAME.	Number of plants.	Maximum tillering.	Minimum tillering.	Average tillering.
24	Finley, 8	37	14	3	6.75
25	Fountain, 12	36	42	8	23.69
26	French Imperial, 3	35	48	4	22.91
27	Fultz, 8	34	14	2	7.32
28	Fultzo-Clawson	47	18	2	7.53
29	Geiger	38	43	4	19.71
30	German Amber	21	22	2	9.76
31	Gold Dust, 9	18	30	2	8.27
32	Golden Drop, 2	50	16	1	8.12
33	Golden Straw, 10	27	16	2	6.22
34	Gorham White, 6	42	17	1	7.09
35	Grecian, 15	44	8	1	4.86
36	Green Mountain Spring, 16	35	31	4	16.77
37	Hallett's Original Pedigree Red	3	11	2	7.50
38	Hallett's Victoria White	1	12	12	12.00
39	Heighe's Prolific, 8	36	14	1	6.41
40	Herisson Brun	25	17	2	7.04
41	Hungarian White Chaff	54	30	1	11.72
42	Imported Mediterranean	3	8	5	6.33
43	Lancaster, 2	42	17	1	6.85
44	Landreth, 11	41	27	1	9.82
45	Mammoth	3	9	1	4.00
46	Martin's Amber, 11	40	21	1	9.25
47	McGhee's Red	29	18	2	8.00
48	McGhee's White	18	21	1	8.38
49	Mediterranean	34	15	1	7.28
50	Mediterranean Hybrid	35	18	2	8.11
51	Mennonite	46	30	2	12.28
52	Michigan Amber, 7	32	22	1	10.00
53	Miller's Genesee Prolific	26	23	1	7.65
54	New York Spring, 3	30	49	8	27.83
55	Nigger, 5	46	23	4	12.28
56	Nonpareil, 12	32	45	3	21.87
57	Pologne ou d'Astrakan	20	25	5	12.90
58	Poole, 7	39	15	2	6.71
59	Pringle's Green Mountain Spring, 16	26	30	2	14.80
60	Purple Stem	36	27	3	16.72
61	Red Amber, 2	39	17	1	7.25
62	Red Fultz, 7	29	24	1	11.41
63	Red Mediterranean	20	17	1	8.60
64	Red Straw, 7.	1	24	24	24.00
65	Rocky Mountain, 8	29	16	2	7.96
66	Rousselin	29	22	5	12.03
67	Royal Australian, 6	37	18	3	9.72
68	Russian May	44	18	1	9.72
69	Rust Proof	35	55	9	26.91

No.	NAME.	Number of plants.	Maximum tillering.	Minimum tillering.	Average tillering.
70	Sandomirka	33	23	1	6.72
71	Saskatchewan Fife, 14	21	62	7	29.33
72	Saskatchewan Spring, 14	29	47	3	24.41
73	Saumur	35	14	1	6.71
74	Scotch Fife, 14	24	53	9	30.62
75	Scott's (bearded), 2	33	14	1	5.57
76	Scott's (smooth), 17	40	25	1	9.07
77	Seigle	21	11	1	6.00
78	Silver Chaff, 15	35	14	2	6.11
79	Silver Medal	29	40	7	24.37
80	Smith's Improved	37	15	1	6.62
81	Surprise	46	13	1	5.41
82	Swamp	31	15	1	5.06
83	Tappahannock	25	13	1	4.68
84	Tasmanian Red, 2	35	16	1	5.40
85	Theiss, 5	49	25	1	9.12
86	Travis, 8	34	17	2	8.02
87	Treadwell (bearded), 4	45	15	1	5.06
88	Treadwell (smooth), 15	51	22	1	6.56
89	Valley	29	16	1	5.03
90	Velvet Chaff	53	23	1	8.26
91	Washington Glass	33	11	1	3.30
92	Wayne County Select	35	16	1	6.60
93	White Blue Stem, 5	38	32	3	8.78
94	White Crimean	21	19	4	11.52
95	White Eldorado, 5	42	22	1	7.40
96	White Rogers, 10	32	23	2	9.50
97	White Russian Spring, 16	28	33	3	13.92
98	White Velvet	28	19	2	6.89
99	Winooski, 6	31	23	4	10.64
100	Yellow Blue Stem, 8	37	33	2	8.18
101	York White Chaff, 15	39	23	2	9.20
102	Zimmerman, 17	48	36	3	11.18
	Average		25.60	3.72	12.37

Grouping the varieties into winter and spring classes, they present the following averages :

No.	GROUPS.	Maximum tillering.	Minimum tillering.	Average tillering.
67	Winter	18.85	2.17	8.22
35	Spring	38.54	6.68	20.33

The following twenty varieties, ten each of winter and spring, produced the greatest percentage of shoots per plant, in their respective classes :

Number.	WINTER.	Average per plant.	SPRING.	Average per plant.
1	Nigger	12.28	Engrain Commun	48.83
2	Mennonite	12.28	Amidonnier roux	38.33
3	Hungarian White Chaff	11.72	“ blanc	37.26
4	Red Fultz	11.41	Epeautre de Tartaire	31.11
5	Champion Amber	11.40	Scotch Fife	30.62
6	Clawson	11.20	Saskatchewan Fife	29.33
7	Zimmerman	11.18	Rust Proof	26.91
8	Winooski	10.64	Silver Medal	24.37
9	Bennett	10.34	Fountain	23.69
10	Michigan Amber	10.00	French Imperial	22.91
	Average	11.09	Average	31.33

The above figures are interesting, but need to be explained, especially the relation between the two groups. The winter varieties are not misleading in their figures. Nigger wheat is one of our worthy varieties, and is to be recommended. Hungarian White Chaff, Champion Amber, Clawson and Michigan Amber are considered meritorious varieties by wheat farmers throughout our northern wheat country. Of the spring growing varieties, the first four are European sorts, the seed of which is firmly enclosed in the husk, and consequently not adapted to the use of the American farmer. Scotch and Saskatchewan Fife are known in the Northwest as standard Spring wheats. It is interesting to know that, of the thirty-six spring varieties, two of our recognized leading ones tiller greatest. But it will be well for growers to note that Scotch Fife and Saskatchewan Fife are identical.

SMUT IN OATS.

During the growing season of 1884 and 1885 an attempt was made to determine to what extent smut existed in our oat fields, and in different varieties, and methods were tried to lessen the loss caused by this vegetable parasite. The testimony was so conclusive that the loss from smut in our oat fields is so very much more than is generally supposed, that the necessity of adopting means to prevent this became very apparent. Brewer states[1] that the oat crop in this country is seldom sufficiently diseased by smut to cause much loss, and little, if indeed any care appears to have been taken for its prevention. That there is a loss which is often very great, is to the contrary true. In 1884 on the Station farm, investigations were made[2] which showed that a loss of nine and one-half per cent. in grain was caused by smut in the field.

During the season of 1886 an attempt was made on the farm to determine how the losses of 1886 would correspond with those of 1884. Areas of ground in different parts of the field were carefully measured off, and the number of healthy and smutted heads growing thereon were carefully counted. The intention was to secure figures from plants growing on such different kinds of soil as the farm afforded, and under the various conditions so as to obtain a fair average. Plats were formed in the oat field by selecting ten rows side by side made by the grain drill, and measuring these off to the length of twenty feet each. All of the panicles in each row were counted, and also the diseased panicles in each of the same. In the following tables, giving the results of these notes the character of the ground upon which the ten rows grew is recorded, as well as the approximate height of the plants. The plats grown in the field on the farm are numbered as plats I, II, III, etc. The general character of the soil is clayey loam.

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[1] Tenth Census of the U. S., 1880. The Cereals, p. 116.

[2] Third Annual Report N. Y. Ex. Station, 1884, p. 382.

CONDITION.		Row.	Total panicles.	Smutted panicles.	Per cent. of smut.
Plat I	White Russian. Situation a dry knoll. Plants of average height.	1	244	13	5.32
		2	322	22	6.83
		3	272	16	5.88
		4	265	19	7.16
		5	308	13	4.22
		6	244	9	3.68
		7	282	16	5.67
		8	314	22	7.00
		9	337	21	6.23
		10	317	24	7.57
	Average	....	290.50	17.50	6.02
Plat II	White Russian. Situation fairly moist and level. Plants taller than the average.	1	382	29	7.59
		2	311	45	14.46
		3	344	34	9.88
		4	218	22	10.09
		5	245	24	9.79
		6	374	13	3.47
		7	381	40	10.49
		8	269	33	12.26
		9	293	30	10.23
		10	291	29	9.96
	Average	....	310.80	29.90	9.61
Plat III	White Russian. Situation fairly moist and level. Plants of average height.	1	296	10	3.38
		2	206	15	7.28
		3	278	20	7.19
		4	281	33	11.74
		5	303	15	4.95
		6	215	12	5.58
		7	238	15	6.30
		8	324	42	12.90
		9	211	16	7.58
		10	283	29	10.24
	Average	....	263.50	20.70	7.85
Plat IV	White Russian. Situation in a hard dry part of field. Plants smaller and shorter than the average.	1	176	6	3.40
		2	209	16	7.65
		3	205	33	16.09
		4	268	32	11.94
		5	239	25	10.46
		6	223	23	10.31
		7	280	27	9.64
		8	244	27	11.06
		9	211	12	5.68
		10	198	33	16.66
	Average	....	225.30	23.40	10.38

Comparing these four field plats, we have the following averages of all the rows of each plat :

	Total panicles.	Smutted panicles.	Per ct. of smut
Plat I	290.50	17.50	5.95
II	310.80	29.90	9.82
III	263.50	20.70	7.71
IV	225.30	23.40	10.28
Average	272.52	22.87	8.48

The totals of the four plats show that, of 10,901 panicles, growing under ordinary conditions in the field, 915 or 8.48 per cent. were destroyed by smut. This field would have appeared very free of smut to the ordinary observer, yet the figures indicate a considerable loss. Dryness of soil seemed to have no special bearing in the matter of percentage of smut, as both the smallest and greatest amounts occurred in parts of the field more elevated and drier than the others. The results of the examinations made by Prof. J. C. Arthur[1] in 1884, are compared below with those above recorded, and as will be noted, the variation is not great.

	Variety.	No. panicles.	Per cent. smutted.
1884	White Australian	7,623	9.87
1886	" Russian	10,901	8.48

The Station experience is, that White Australian smuts worse than White Russian, hence a higher percentage was to be expected. However, were equal numbers of panicles counted in each case, it is possible that the percentages might have been brought into closer relations.

The interesting question here arises, is smut transmitted to the successive crops as produced each year, and if so, what means can be taken to prevent the propagation of this vegetable parasite?

In 1885, while visiting a large grain farm in Seneca county, my attention was called to a field of American Triumph oats, embracing several acres, so devasted by smut as to ruin a goodly portion of the crop. The field was harvested, and from the crop, enough seed was secured for the Station to carry on the following experiments. Four plats were planted, being as widely separated as distance on the Station land would allow. Plat A was situated in the experimental plats, on the north-east side; plat B in a south-east exposure, on the opposite side of the farm; plat C, on the very south side of the grounds, and plat D in the north-west corner, all on a 125 acre farm. The seed of all the plats was untreated, and planted as received from Seneca county. The plats were treated alike. The results obtained were as follows:

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[1] Third Annual Rep't N. Y. Ag'l Ex. Station, 1884, p. 382.

CONDITIONS.		Row.	Total panicles.	Smutted panicles.	Per cent of smut.
Plat A	American Triumph. Retentive clay loam. Plants medium h'g't. Rows 33 feet long.	1	537	181	33.70
		2	618	205	33.15
		3	695	147	21.15
		4	656	201	30.64
		5	680	173	25.44
	Average	....	637.2	181.4	28.81
Plat B	Amer. Triumph. Soil hard clayey loam, somewhat stony, on knoll. Plants below medium size. Rows 10 feet long.	1	59	20	33.89
		2	57	20	35.08
		3	63	20	31.74
		4	60	9	15.00
		5	57	22	38.59
	Average	....	59.2	18.2	30.86
Plat C	Amer. Triumph. Soil clayey loam, good. Plants below medium size. Rows 10 feet long.	1	68	3	4.41
		2	63	7	11.11
		3	80	5	6.25
		4	66	11	16.66
		5	85	17	20.00
	Average	....	72.4	8.6	11.68
Plat D	Amer. Triumph. Average soil clayey loam, good. Plants of aver- height. Rows 10 feet long.	1	164	15	9.14
		2	135	20	14.81
		3	132	29	21.21
		4	140	48	34.28
		5	107	30	28.03
	Average	...	135.6	28.4	21.49

Combining the averages of the four plats, and averaging these, we obtain the following figures :

	Average no. panicles per plat.	Average smutty pan. per plat.	Average per cent. of smut per plat.
Plat A	637.2	181.4	28.81
Plat B	59.2	18.2	30.86
Plat C	72.4	8.6	11.68
Plat D	135.6	28.4	21.49
	226.1	59.15	23.21

The loss in the above four plats is very large, as can be easily seen by reference to the figures, even when considering plat C, where the loss is least. Under such circumstances, where disease seems carried on from generation to generation, to the detriment of both crop and man, a vigorous attempt should be made to secure a practical remedy against such a trouble. With this object in view, the following experiments were tried. The seed planted was of the same as that used in plats A, B, C, and D. The soil was well adapted to the oat plant, and all the experiments were carried on side by side under conditions as nearly alike as it was possible to secure. Five rows were planted in each experiment, each being 33 feet long and two feet feet apart. Seed was distributed about one inch apart in the row. Before planting it was rolled in slacked lime so as to separate the grains.

CONDITIONS.		Row.	Period of seed soaking.	Total panicles.	Smutted panicles.	Per cent of smut.
Plat E	Soaking solution at rate of 4 ozs. copper sulphate and one gal. water. American Triumph.	1	17½ h.	415	3	0.72
		2		568	11	1.91
		3		538	8	1.48
		4		518	4	0.77
		5		535	20	3.92
	Average			514.8	9.2	1.78
Plat F	Treated as E. American Triumph.	1	40 h.	535	0	0
		2		593	0	0
		3		571	0	0
		4		559	0	0
		5		489	0	0
	Average			549.4	0	0
Plat G	Soaking solution at rate of 4 ozs. iron sulphate and one gal. water. American Triumph.	1	17½ h.	609	77	12.64
		2		619	119	19.22
		3		591	115	14.95
		4		686	82	11.95
		5		661	130	19.66
	Average			633.2	104.6	16.51
Plat H	Treated as G. American Triumph.	1	40 h.	682	92	14.87
		2		655	46	7.02
		3		649	103	15.87
		4		671	84	12.51
		5		667	79	11.84
	Average			664.8	80.8	12.15
Plat I	Soaking solution 1-2 oz. caustic potash, 1 1-2 pint of water. American Triumph.	1	17½ h.	483	0	0
		2		522	0	0
		3		567	0	0
		4		475	0	0
		5		503	0	0
	Average			510	0	0

CONDITIONS.		Row.	Period of seed soaking.	Total panicles.	Smutted panicles.	Per cent. of smut.
Plat J	Soaked in solution of salt dissolved in hot water. Soaked after cooling. American Triumph.	1	17½ h.	550	25	4.54
		2		563	14	2.48
		3		581	23	3.95
		4		595	31	5.21
		5		584	24	4.10
	Average			574.6	23.4	4.07
Plat K	Soaked in solution one oz. nitrate potash (saltpetre) 1 1-2 pint water. American Triumph.	1	17½ h.	605	80	13.22
		2		631	78	12.36
		3		544	41	7.53
		4		575	60	10.43
		5		582	41	7.44
	Average			587.4	60	10.21
Plat L	Soaked in fresh cattle urine only. American Triumph.	1	24 h.	554	19	3.42
		2		538	26	4.83
		3		575	16	2.78
		4		573	15	2.61
		5		548	21	3.83
	Average			557.6	19.4	3.47
Plat M	Soaked in solution ten parts by weight fresh cattle urine, 3 parts quick lime. American Triumph.	1	24 h.	553	8	1.44
		2		528	17	3.21
		3		505	28	5.54
		4		546	15	2.72
		5		471	20	4.24
	Average			520.6	17.6	3.38
Plat N	Soaked in strong solution of Castile soap, water and quick-lime. American Triumph.	1	24 h.	544	11	2.02
		2		582	4	0.68
		3		569	3	0.52
		4		626	26	4.15
		5		601	22	3.66
	Average			584.4	13.2	2.25

In order to compare the efficacy of the different treatments, the above ten plats are tabulated below in their order of increase in percentage of smut, beginning at the minimum. In every one of the ten experiments, the testimony is positive in demonstrating that good has resulted from the treatment of the seed. In one case only has the percentage of smut exceeded one-half the average percentage in plat A, while generally the loss is very small, and in two cases none at all.

Plats.	Av. number panicles.	Av. number smutty panicles.	Av. per cent. of smut.
F	549.4	0	0
I	510.0	0	0
E	514.8	9.2	1.78
N	584.4	13.2	2.25
M	220.6	17.6	3.38
L	557.6	19.4	3.47
J	574.6	23.4	4.07
K	587.4	60	10.21
H	664.8	80.8	12.15
G	633.2	104.6	16.51
A untreated	637.2	181.4	28.81

Plats F and I produced no smut, while a slight amount gradually increasing in the order given, is found in E, N, M, L, and J. The three last K, H and G, have a much higher percentage.

The practical value of these experiments, as well as the ease with which the remedies tried can be adopted on a large scale, are worthy of consideration. Copper sulphate can be purchased at retail for about 15 cents per pound and its use is attended with very little trouble. Seed soaked 17 1-2 hours in this solution were found to produce a slight amount of smut. Soaked 40 hours, all germs of the fungus were killed. Caustic potash, a cheap substance for sale in most groceries, or easily obtained by leaching wood ashes, was most effective in destroying all smut within 17 1-2 hours. A solution of Castile soap in water, with enough quick-lime to color the liquid milky white, proved quite effective, destroying, nearly all the smut. Cattle urine, which has been recommended by some farmers, is always accessible, and can be profitably used. Referring to these figures, it would seem that, considering the ease with which farmers can procure most of the substances tried, there can be no reasonable excuse for loss of grain from smut, provided no attempt is made to check the development of the same. The treatment of the grain with the various substances seemed to produce no injurious effect on the plants, for all were as equally strong and healthy as the untreated seed.

SEEDING PERIODS FOR BARLEY AND OATS.

Two tracts of land, 66 by 33 feet, were laid off into sub-plats, 11 by 33 feet, there being six divisions on each, or twelve in all. The large plats were separated by a walk two and one-half feet wide. The soil was clayey-loam, quite level, and had been prepared by being ploughed and harrowed the previous fall. At time of planting the ground was spaded and worked with a hoe. Fertilizer was applied at the rate of 400 lbs. per acre. On plat A. 12, six successive seedings of White Australian oats were made, at weekly intervals. On A. 13, the same number of seedings were made in the same manner with common two-rowed barley. The quantity of seed applied in both cases was a quart measure full, the grain being shaken down somewhat, and then struck off level. The seed was broadcasted by hand and raked in. The purport of the experiment was, not to determine questions relative to productiveness, but concerning the periods of maturity resulting from a wide range of time in planting. The results are tabulated as follows:

PLAT.		Plant'd	Vegetated.	Panicled.	Ripe.	Cut.	Weight of grain.	Weight of straw.	Weight of struck bush
Barley...	I	Mar. 26	April 14	June 10	July 16	July 19	23 lbs. 12 oz	20 lbs. 4 oz	53 lbs. 8 oz
	II	April 2	" 15	" 10	" 16	" 19	21 " 12 "	19 " 0 "	54 " 4 "
	III	" 9	" 17	" 10	" 16	" 19	23 " 4 "	22 " 8 "	53 " 8 "
	IV	" 16	" 22	" 13	" 19	" 22	20 " 12 "	22 " 0 "	52 " 12 "
	V	" 23	" 30	" 13	" 21	" 22	25 " 4 "	27 " 0 "	51 " 12 "
	VI	" 30	May 7	" 17	" 31	" 31	17 " 8 "	22 " 12 "	48 " 8 "
Oats.....	I	Mar. 26	April 16	June 11	July 19	July 19	22 lbs. 4 oz	35 lbs. 8 oz	
	II	April 2	" 17	" 14	" 19	" 19	20 " 8 "	33 " 12 "	
	III	" 9	" 19	" 14	" 26	" 27	22 " 0 "	41 " 8 "	
	IV	" 16	" 26		" 26	" 27	22 " 8 "	44 " 4 "	
	V	" 23	May 1		" 27	" 27	27 " 0 "	53 " 0 "	
	VI	" 30	" 7	" 27	" 31	" 31	21 " 8 "	35 " 8 "	

It is to be noted that the periods intervening between the vegetations of the first three plats, in both cases, are very short, there being but three days' difference in planting at two weeks interval. With both species of grain, there was much resemblance in the rapidity of growth. The first three seedings developed much alike, the three barleys all panicling, ripening and being cut at the same time. Oat plats I and II ripened about a week earlier than III, which ripened with IV and V. Plats IV and V of the barley made much the same growth during the season, and were cut at the same time. Plats VI in both cases ripened later than the others, and the plants never attained the growth in height or robustness seen in the others. In both crops the maximum yield of grain seemed to be secured in the fifth seeding. The reason for the lighter yield in the sixth barley seeding is that the quantity of seed used is about one-half that applied in the other plats.

This one experiment produces evidence which would tend to indicate that we might commonly plant our oats and barley rather earlier than is practiced. Plat I in both cases went through a number of freezings, and snow in

April, yet the crops were earlier than others in this region, and the plants strong and productive. The barley in particular was cut before any other field in this vicinity, so far as is known. The seed was placed at, or very near, the surface of the ground, but at this time of year there is so much moisture in the soil no difficulty was experienced in securing early vegetations.

COMPACT VS. LOOSE SEED-BED.

Plat B. 16, 33 feet wide, was ploughed, harrowed and fitted in the most careful manner. Fertilizer at the rate of 400 lbs. per acre was applied to the same. Beginning on the north end, extending south, twenty feet were compacted as much as possible. A heavy iron hand roller was worked over the surface, and afterwards the ground was carefully tamped. By this method the soil was made very compact, at least on the surface. Twenty feet extending south of this space were treated just the reverse of the preceding. The ground was hoed, and the soil loosened as much as possible. The first twenty feet, A^1 were marked into ten rows, each 33 feet long, and planted on April 22 to White Australian oats, and the covering on each drill rolled firmly over the seed. The second twenty feet, A^2 were marked into ten rows, planted to the same kind of oats in a like manner, and the soil loosely laid upon the seed. The forty feet remaining were treated identically with the preceding forty, the third set of twenties, B^1, being compacted and ten rows of Imperial barley planted, and the fourth set, B^2 made very loose, and ten rows of the same kind of barley planted.

Practically speaking, the two plats of oats vegetated together, and the barleys likewise. No noticeable difference was to be seen in these plats during most of the growing season. The larger weeds were pulled from A^1 and B^1, but the soil was not otherwise disturbed. A^2 and B^2 were hoed whenever necessary, and the soil kept loose and porous. On July 22 the following conditions existed on A^2 and A^2. The plants on A^1 were erect and ripe enough to cut. Those on A^2 had been levelled by the wind and rain of a few days previous, and were a tangled mass, and not ripe enough to cut within a week of those on A^1. On July 29, the ten rows on A^2 were marked ripe enough to cut. Those on A^1 were nicely cradled; those on A^2 were cut with the scythe, owing to the lodged, tangled condition of the straw.

No special and striking difference was noted in case of the barley on B^1 and B^2, excepting in maturity. B^1 was ripe enough for cutting on July 29, B^2 not till Aug. 4. The following table contains figures of interest regarding both of these crops.

Plats.		Weight of grain.	Weight of straw.	Weight of struck bushel.
Oats .	A^1	21 lbs. 12 oz.	35 lbs. 0 oz.	33 lbs. 2 oz.
	A^2	29 " 0 "	39 " 8 "	32 " 2 "
Barley	B^1	21 " 0 "	21 " 8 "	42 " 12 "
	B^2	17 " 8 "	23 " 12 "	42 " 8 "

The White Australian oat, as grown in this vicinity, seems to be especially weak in the straw, and is easily lodged by winds and rain of no very great violence, days before being suitable for cutting. In this experiment, as before noted, the plants growing on soil specially compacted remained erect and were easily cradled, while others growing alongside of the same rows in a loose seed bed, lay prone to the earth. In view of the circumstances, it seems difficult to explain the erectness of the straw in one set of rows, and its decumbency in the other, if we attempt to ascribe the cause for this erectness to other than the firm seed bed.

WHEAT SELECTION EXPERIMENT.

In the fall of 1885 land was prepared for the following experiment. The soil was thoroughly plowed and fitted, and equally treated on all parts as nearly as possible. Ten rows were run across the plat, a distance of 33 feet, each being two feet apart. On September 25, five rows were planted to 1000 large grains of Clawson wheat, as selected from the grain bin. The five remaining rows were planted to small, shrivelled grains, of the same variety, selected from the same bin. The seed was placed about an inch and a-half apart in the row. No fertilizer was used.

The seed in these ten rows vegetated at practically the same time, though a greater percentage of plants appeared from large than from small seed. By winter, the former were much larger and more robust than the latter, and better fitted to pass the winter than the small seed plants.

The spring of 1886 showed the plants of the large seed much larger and stronger than from the small, and in the latter part of May this difference became most striking, the plants from large seed being nearly if not quite three times as large and strong as the others. On June 5, the large plants began to panicle several days in advance of the small. On July 24 the plants from large seed were ripe and gave an average height of three feet eight inches, the panicles a length of 5+inches. Plants from small seed were ripe July 28, averaged three feet two inches high, and panicles 5 ‡ inches long. On July 28 the panicles in the rows of both plantings were counted, with the following result :

Large Plants.		Small Plants.	
1st row	431 panicles	1st row	448 panicles
2nd "	738 "	2nd "	574 "
3rd "	754 "	3rd "	851 "
4th "	783 "	4th "	402 "
5th "	766 "	5th "	430 "
Total	3472 "	Total	2205 "
Average	694.4 "	Average	441 "

On July 28 all ten rows were cut. After thrashing, the following results were found to have been obtained :

	Large Plants.		Small Plants.	
Rows.	Straw yield.	Grain yield.	Straw yield.	Grain yield.
1	1 lb. 15 ozs.	– lb. 9 ozs.	1 lb. 12.5 ozs.	– lb. 11 ozs.
2	3 " 12 "	1 " 11 "	2 " 8.5 "	1 " 0 "
3	3 " 12 "	1 " 11 "	1 " 6. "	– " 9 "
4	4 " 5 "	1 " 12 "	1 " 12.5 "	– " 13 "
5	3 " 13 "	1 " 13 "	1 " 12. "	– " 10 "
Aver'g	3 " 8.2 "	1 " 8 "	1 " 13.5 "	– 11.8 "

NOTES ON FORAGE PLANTS.

ALFALFA (*Medicago sativum*).

In the spring of 1885, a part of A. gore, comprising 1-17.5 acre was sown to alfalfa. The land, a heavy clay-loam, was prepared as for clover, commercial fertilizer being applied at the rate of 400 lbs. per acre. The growth of the plants for 1885 was strong and healthy, but no crop was taken from the land, the plants being too small. The winter was passed in good form, and by April 12, 1886, the new leaves were beginning to appear. By May 12 the plants had a very fine growth, and were succulent, foliaceous, and formed quite a mass, with an average height of 18 inches. On May 28 the plants were fit to cut, and the stems were as tender and sweet as clover growing near by. On June 1 the heads began to appear, and by June 4 were in bloom. Four crops were cut during the season, as follows:

June 11	yield at rate of	5,166	lbs. dry	fodder per acre.
July 19	" " " "	14,385	" green	" " "
Aug. 18	" " " "	11,795	" "	" " "
Sept. 23	" " " "	8,172	" "	" " "

That cut on June 11 had an average height of two feet. The stems were somewhat woody, but not tough, were sweet to the taste, and drier than clover. This crop was dried as hay, and eaten with much relish by the cows, seven in number.

The last crop cut, Sept. 23, was very rich and succulent looking, and much relished in the green condition, as were the other crops not dried for hay. All of the live stock at the Station eat alfalfa with avidity, whether dried or green.

In 1882, two plats of 100 sq. ft. each were planted to alfalfa. The seed bed was heavy, cold and retentive, with a very solid clay bed underlying at a depth of about three feet. The alfalfa grew and flourished, although sparingly fertilized, and in 1886 was apparently as strong and vigorous as in 1883. The first cutting from one of them, in 1886, yielded at the rate of over ten tons per acre of green fodder, and four crops were cut. No changes of weather or temperature seem to have affected this plant thus far as grown here. Station experience warrants us in believing as desirable the trial of this crop on the farm for green food.

SWEET CLOVER (*Melitotus alba*).

One plat of 100 square feet was sown in 1885 to this crop. The soil was clay loam, cold and retentive. The growth the first year was of no special consequence. On April 12, 1886, the new growth appeared where last seasons plants were located. On April 25, the first bloom was seen, and it is to be noted that plants were in bloom on this plat until late in the fall, after frosts. By May 8 the growth was very forward, the foliage profuse, heavy and of a deep green color. On May 11 the height of the plants averaged two feet, and the bed was a mass of luxuriant, rich green foliage. Fifty square feet of this was cut, yielding 52 lbs. of green fodder, or at the rate of 45,292 lbs. per acre—an enormous yield.

The green fodder of this plant, in its most inviting form, was offered to seven cows at a season when succulent food is most relished by live stock, i. e., in spring before it is usually accessible. One cow refused to eat at all, while six ate in varying degrees, some voraciously, others daintily. The interesting point is, that, these six cows suddenly stopped eating within five minutes of the time the fodder was first given them, and all refused absolutely to touch it at all thereafter. The horses of the farm ate it sparingly.

The feeding value of this plant has been the subject of some discussion in this country. Most of the lesser writers on agriculture do not refer to the Sweet Clover at all. Sinclair in Hortus Gramineus Woburnensis, 1824, does not mention this species. A few years later, in 1836, Lawson[1] states that it is very rare, being only found in two or three places in Scotland. Referring to *Medicago officinalis*, the yellow species of Sweet clover, he says: "Cattle in general are very fond of this melilot when cut in a young and tender state, but, like all the rest of the genus, when allowed to arrive at full bloom, its stalks become so hard and woody that the tops and leaves only are fit for being eaten." Prof. Lindley[1] notes that this plant has been the subject of many trials in England, but says that it has been found too watery when young, and too sticky when old. Gould[2] notes that Sweet Clover has been used for soiling. He thinks that if used for this purpose it should be cut when quite young, as at flowering time, and even before, the stems are too woody to be chewed by animals. He says however, they are little used for this purpose, being too watery when young, and too woody when old, to be of use for meat or milk. Cattle, however, are quite fond of a mixture of a small quantity of it with their food, when quite young, and before it becomes woody. At the annual meeting of the N. Y. State Dairymen's Association, in 1885, the question of the influence of this plant on the milk was discussed. Little seemed to be known regarding this, other than theoretical. Mr. Slocum[3] stated that he had seen cows eat this plant with great avidity in Florida. The editor[4] (Sec. Shull ?) remarks that when gathered before seeds are formed, it is valuable for stock food, but gives no evidence in support of his statement, which I have strong reasons for doubting.

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[1] Agriculturalists Manual, 1836, p. 163-164.

In consideration of the very heavy growth of green fodder, it would appear as though this crop might be grown with profit for turning under. Certain it is, cattle and horses do not relish it, probably owing to its chemical nature. The plants flourish all through the growing season, attain a height of six feet, and produce a great quantity of bloom, which is much frequented by honey bees.

ALSIKE CLOVER (*Trifolium hybridum*).

In 1885, a plat of 100 sq. ft. of this plant was planted. The growth for the first year was small, and no crop was cut. The winter was passed satisfactorily. On May 12, 1886, a finely colored, dense mass of foliage covered the plat to a height of eight inches. The stems of the plants at this time were delicate and succulent; the foliage soft and light green in color. May 28 bloom appeared, and the foliage was advanced and luxuriant. June 12 the plat was in full bloom, and but few heads had turned at all, and the plants were in suitable condition for cutting, and on June 14 were cut, and yielded at the rate of 7,830 lbs. of dry hay per acre.

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[1] Morton's Cyclopedia of Agriculture, 1869, p. 421.

[2] Trans. N. Y. State Ag'l Soc. 1872-76, p. 73.

[3] Ninth Annual Report N. Y. State Dairymen's Ass'n, 1885, p. 60.

[4] Ibid, p. 61.

Alsike clover, both in leaf and stem, is very soft and pleasant to the touch, more so than any of our other clovers, unless we except the White. The quality of hay made from it is very superior, and is much relished by the station cows. The plants produce a profusion of bloom, and are consequently a rich feed for bees. Owing to the plants being delicate and succulent, they are somewhat affected with rust, though to no serious extent. It lacks the stiffness of red clover, and hence does not hold itself erect at maturity so well as the Red. The average height of that grown at the Station was 18 inches. It is evidently well adapted to this region.

GRASSES.

ORCHARD GRASS (*Dactylis glomerata*).

The new foliage of this grass first appeared about April 14, and developed with much vigor. The growth was coarse and rank, as is characteristic of this species. On May 12, two days after the first flower heads had appeared, Orchard grass appeared to have an excess of foliage over all the other grasses in the field. Though the flower stalks were but just appearing, the leaves were very high and thick, and stood to a height of over two feet. On June 1, bloom first appeared, and by the 14th the plants were sufficiently advanced to admit of cutting. One hundred square feet yielded at the rate of 9,570 lbs. of hay per acre. The plants averaged four feet in height, being the tallest at the time of cutting of any growing on the plats, and the hay was quite heavy and coarse.

For early hay, this variety excels anything that has been grown at the Station. What appears as an objectionable feature to this grass is its habit of growing in tufts or hassocks. The roller has been recommended to obviate this trouble, and though it has been tried at the Station, does not seem to be effective. What may be considered by some as an undesirable feature, and by others not, is the habit this plant has of spreading itself in regions where planted. The wind disperses the seed with great ease, so that they become distributed over a considerable area. In our forage plats, one of the greatest pests has been Orchard grass, on account of its habit of seeding itself.

MEADOW OAT GRASS (*Avena elatior*).

This variety develops somewhat earlier than Orchard grass, the new foliage appearing April 12, and flower heads May 8. On June 1, bloom was noted, and on the 14th the plat was cut, although this might have been done to advantage several days earlier. One hundred square feet yielded at the rate of 6,525 lbs. per acre. The plants averaged 3 feet 8 inches high, and were slender and graceful. The foliage is fine rather than coarse, soft, and fairly profuse. It has a very healthy, vigorous, deep green appearance. As fed to the Station cattle, both green and dry, it seemed to be much relished. It character, delicate and soft, makes it desirable as a palatable food, of easy assimilation.

Meadow Oat grass produces a very nice second crop. On August 5 the plants had so developed as to present a very fine appearance in foliage, and by the latter part of August had many heads in bloom, and were ready for cutting. This variety is well adapted to fairly moist, alluvial meadow lands.

MEADOW FOX-TAIL (*Alopecurus pratensis*).

This is without doubt our earliest grass. On April 12 the new foliage made its first appearance, and by the 24th, less than two weeks later, the flower heads had appeared and a heavy, rich herbage covered the plat. May 3, the heads were in bloom, and by the 12th the plants were mostly in bloom, and fit for cutting, although not cut till June 4, when 100 sq. ft. yielded at the rate of 12,180 lbs. per acre of green fodder, This green food was eaten with much relish by the Station cows, even after a liberal grass feed during the earlier part of the day.

That which is especially commendable in this grass, is its earliness and the character of its herbage, which is soft and pleasant to the touch. It is not remarkably foliaceous, yet is fairly so. It has an erect, strong growth. It is well adapted to moist meadow lands. For early pasturage it is superior to any variety grown at the Station.

JOHNSON GRASS (*Sorghum halapense*).

In 1885 a small plat of clayey loam was seeded down to this variety. The seeds did not vegetate very well, however, and those plants which grew did not develop to a satisfactory extent. Upon the advent of severely cold weather the plants were entirely killed to the ground, although some were strong and vigorous. Early in the spring of 1886 the strongest, largest roots were examined, and a specimen was placed in the greenhouse, but did not grow, as it had been killed by the winter's cold. As warm weather came on, many seeds germinated, and in 1886 the plat, one-half of which had been re-seeded, became covered with plants. A fair growth was made, and on July 7 the first panicles appeared, and from this time on the growth was fairly rapid. On Aug. 4 the plants averaged four feet in height, and were very succulent and had a fair amount of foliage. By August 26 some of the plants had attained six feet, and the growth was decidedly rank. At this date it was in full bloom, and the seeds in the dough state.

The plants stool strikingly. It appears much like a dwarf sorghum of some types. Dried it is rather inferior, and very coarse. It might make a good crop for soiling in some localities, but in this latitude the inclemency of weather makes it entirely impractical to grow it, so long as we possess other grasses far more valuable.

BERMUDA GRASS (*Cynodon dactylon*).

This grass has been grown at the Station for two years. It would be almost impossible to harvest a crop from it. It creeps along the surface of the ground, throwing down roots from every node, and thus tying itself most firmly to the surface soil. It rapidly spreads, but the first frost of consequence kills its foliage completely. It does not winter here, the roots being entirely killed, but its seed, if sown, will vegetate in a lingering way for several years. It has no value whatsoever, so far as can be seen for this latitude, and this is perhaps fortunate when we consider what a pest it is considered in some localities South. The growth is densely matted on the surface of the ground, yet it does not attain a height of but three or four inches.

SHEEP FESCUE GRASS (*Festuca ovina*).

The first appearance of the new foliage of this variety was on April 12, and the growth was quite rapid till cutting time—June 4. On April 27 panicles first appeared, and by June 4 the plants were sufficiently in bloom to be cut. Fifty sq. ft. yielded at the rate of 6,090 lbs. of green fodder per acre. The body of the crop mostly consists of wiry, tough stems and flower heads, while the leaf growth is very fine and meagre.

Cattle do not relish this grass, so far as Station experience goes. The upper portions of the plant, consisting of panicle and part of the stem, were eaten, while a considerable share of it, in the main very tough, was rejected. It was noticeable that, in eating the stems, the cows gritted their teeth to a considerable extent.

In the plants grown at the Station of Red Fescue (*F. rubra*) and the Hard Fescue (*F. duriuscula*) I could detect no difference from them and *ovina*. This was evidently the result of improperly named seed.

Report of the Horticulturist.*

INTRODUCTION.

The attempt has been made the past season to devote more attention than usual to experimental work. As in previous years a large part of the time has been devoted to describing varieties in the garden and determining synonyms, the cabbage and lettuce being the plants receiving special attention in this report. The remainder of the time has been devoted to a study of other subjects as named below. The statistical part of our work of the past season is chiefly reported by the assistant horticulturist, on whom the labor of note taking has largely fallen.

A synopsis of the subjects treated is as follows:

A test of varieties and a report of experiments with the potato.
A study of root-growth.
Notes on orchard fruits, and seedlings.
Notes on the grape.
Notes on the tomato.
Notes on insects and insecticides.
Hyposulphite of soda as a preventive of scab on the apple and pear.
The influence of foreign pollen upon fruits.
An attempt to secure a record of the soil moisture.
An elaborate garden test, with a description of the principal varieties and a list of synonyms of the heading cabbage.
A revision of the work upon lettuce published in our last report, with notes upon hitherto untested varieties.

POTATO.

A TEST OF VARIETIES.

As several new varieties of the potato have been received at the Station each season, our list became so large that it seemed desirable to discard those grown in previous years that appeared to have no special value or interest. The past season 45 hitherto untested varieties, mostly new introductions or unnamed seedlings, with 14 grown last season that we desired to further test are the only ones we have to report upon, with the exception of 66 varieties that have been grown successively since 1883. The last series is connected with an experiment intended to show how far the relative productiveness of varieties can be depended upon through consecutive seasons.

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*E. S. Goff.

In all cases the seed planted was single eyes ; the rows were three and a half feet apart, and the eyes placed one foot apart in the rows. The soil, which was in a moderate state of fertility, was ploughed in the fall of 1885 and again in the spring. No manure was applied, and the ordinary cultivation was given.

As usual, the reported yield is calculated upon the basis of 100 hills. The sorts with "1885" appended in the table were grown last year also; the others have not been previously grown at the Station.

The varieties with the data noted are as follows:

POTATO—A TEST OF VARIETIES.

	Date planted.	Number of eyes planted.	Date of first vegetation.	Number of eyes that vegetated	Date of first bloom.	Date when tops were dead.	Days from planting.	Calculated on the basis of one hundred hills.				Notes on Foliage.
								Numb. of merch'bl tubers.	Weight of merch'bl tubers.	Total number of tubers.	Total weight of tubers.	
									lbs. oz.		lbs. oz.	
Alexander's No. 103	April 28	26	May 17	26	......	Sept. 11	136	273	77-15	365	81-15	Foliage abundant, vigorous.
Alexander's Prolific Montreal	" "	"	" 17	26	....	" 28	153	331	79- 2	423	83-10	Less abundant than above.
American	" "	5	" 18	5	June 29	" 8	133	220	55- 0	*220	55- 0	Abundant, vigorous.
Arundel Rose	" "	26	" 17	25	" 21	" 1	125	236	70- 9	292	72-13	Vigorous.
Baraboo White	" "	"	" 18	20	......	" 9	134	200	67- 3	310	71- 6	Vigorous.
Bodega Red, (1885)	" 29	"	" 17	23	....	" 15	139	74	14- 6	330	25-13	Medium.
Brownell's No. 55	" 28	"	" 18	24	....	" 5	130	379	77- 0	496	83- 6	Vigorous.
Buffalo Bill	" "	"	" 15	26	June 21	" 7	132	365	132-11	581	144-10	Very abundant and vigorous.
Burbank, (1885)	" 29	"	" 18	"	July 1	" 15	139	281	100- 6	358	103-15	Vigorous.
Burpee's Empire State, (1885)	" "	"	" 19	"	June 24	" 15	139	288	116- 6	415	123- 3	Vigorous.
Charles Downing	May 11	12	" 24	12	" 3	Aug. 21	102	458	62- 8	642	70- 9	Very vigorous, abundant.
Charter Oak, (1885)	April 29	26	" 17	24	June 24	" 30	123	254	71- 8	404	76- 3	Vigorous.
Crane's Potentate, (1885)	" "	"	" 15	26	" 17	" 10	103	185	44- 8	238	46- 6	Vigorous.
Dakota Red, (1885)	" "	"	" 17	"	July 2	" 18	111	196	44-15	273	49-12	Very vigorous, abundant.
Early Albino	" 28	"	" 18	"	June 19	" 30	124	304	75- 4	473	86-12	Abundant and vigorous.
Early Dawn	" "	"	" 18	"	July 6	Sept. 1	126	292	66- 6	315	68- 7	Vigorous.
Early Dunham	" "	"	" 15	24	June 24	Aug. 10	104	242	49- 3	362	55- 3	Moderately vigorous.
Early Eclipse	" "	"	" 18	23	" 19	" 30	124	213	64- 4	348	71- 0	Abundant, very vigorous.
Early Modena	" "	"	" 18	25	......	Sept. 1	125	304	62- 4	440	67-11	Very vigorous.
Early New Zealand	" "	"	" 18	24	....	Aug. 11	105	125	32- 3	221	3 - 1	Medium.
Farmer's Favorite	" "	"	" 17	26	....	" 19	113	204	35- 7	389	48- 3	Medium.
Finch's Early Perfection, (1885)	" 29	"	" 17	26	June 19	" 5	98	192	36-11	342	45- 4	Medium.
Duplicate	May 17	52	" 31	52	July 8	Sept. 18	124	223	58-10	354	66- 0	Medium.
General Logan	April 28	26	" 17	21	....	Aug. 16	110	195	44-15	238	48- 7	Vigorous.
General McClellan	" "	"	" 18	24	....	" 11	105	238	47- 8	333	51-13	Medium.
Giant Osceola	" "	"	" 17	25	....	July 26	89	60	8-12	152	15- 4	Feeble and scanty.
Green Mountain	" "	"	" 17	24	June 29	Aug. 16	110	237	37-12	342	43- 8	Very vigorous.
Hampden Beauty	" "	"	" 15	22	" 23	" 10	104	255	44- 5	368	50- 9	Vigorous.
Harlequin	" "	19	" 15	10	......	Sept. 9	134	....	......	90	2- 8	Lvs. vari. Foliage varieg't'd.
James G Blaine	" "	26	" 17	26	June 19	Aug. 10	104	223	45- 5	342	51- 2	Vigorous.
Keystone	" "	"	" 17	26	....	" 9	103	150	18-10	300	25- 7	Vigorous.
Late Strawberry	" "	"	" 17	24	June 26	" 2	96	104	16-11	167	19-15	Medium, pale green.
Monitor	" "	"	" 15	26	" 19	" 16	110	262	65- 6	350	69- 4	Vigorous.
Morning Star	" "	"	" 18	26	July 6	" 16	110	312	68-13	538	76-13	Very vigorous, abundant.
New Queen, (Early)	" 29	"	" 15	25	June 23	" 16	109	286	43- 6	328	58- 3	Very vigorous.

***There were no unmerchantable tubers in the five hills planted.**

POTATO—A TEST OF VARIETIES—(*Continued.*)

	Date planted.	Number of eyes planted.	Date of first vegetation.	Number of eyes that vegetat'd	Date of first bloom.	Date when tops were dead.	Days from planting	Calculated on the basis of one hundred hills.				Notes on Foliage.
								Numb. of merch'bl' tubers.	Weight of merch'bl' tubers.	Total number of tubers	Total weight of tubers.	
Nott's Victor (1885)	April 29	26	May 15	26	June 23	Aug. 18	111	258	**62- 8**	373	**68 -2**	Vigorous.
O. K. Mammoth (1885)	" "	"	" 18	25	....	" 25	118	80	**22- 9**	200	**28- 8**	Vigorous.
Oswego Wonder	" "	"	" 19	"	....	Oct. 1	156	152	**32- 4**	200	**35- 0**	Vigorous.
Pearl of Savoy (1885)	" "	"	" 15	26	June 21	Aug. 9	103	138	**34-12**	265	**40-12**	Feeble.
Pecan	May 22	"	June 1	"	July 8	Sept. 18	143	515	**98- 7**	888	**114- 9**	Very vigorous, abundant.
Putman's Favorite	April 29	"	May 17.	25	....	Aug. 20	113	......	....	......	....	Vigorous.
Putman's Junks	" "	"	" 17	26	....	Aug. 31	124	446	**102-10**	681	**114- 3**	Very vigorous and abundant.
Rose's No. 74	" "	"	" 19	"	June 18	Aug. 21	114	258	**65- 4**	304	**68 -4**	Very vigorous and abundant
Rural Buttercup	" "	"	" 17	"	....	July 26	88	100	**12-14**	165	**15- 4**	Feeble.
Snow Queen	" "	"	" 17	"	....	Aug. 16	109	212	**45- 7**	435	**57- 1**	Very vigorous, abundant.
Thorburn (1885)	" "	"	" 15	"	June 17	Aug. 17	110	288	**76- 7**	515	**89- 7**	Very vig., abund't, compact.
Thunderbolt	" "	"	" 18	25	....	Sept. 8	132	360	**78- 4**	500	**85-12**	Very vigorous, abundant.
Vanguard (1885)	" "	"	" 15	24	June 19	Aug. 18	111	225	**56- 6**	337	**62- 9**	Very vigorous. abundant.
Vick's Extra Early (1885)	" "	"	" 15	"	... ...	Aug. 12	111	108	**27- 0**	228	**33- 9**	Vigorous, abundant, comp't.
Webb's Early	" "	"	" 17	26	June 23	Aug. 17	110	227	**50- 8**	381	**60- 1**	Vigorous, abundant.
"X X" (1885)	" "	"	" 17	"	" 29	Aug. 14	107	142	**25- 8**	354	**39- 2**	Very vigorous, abundant.
Seedling from J. C. Robinson No. 7 (1885)	" "	"	" 18	23	July 6	Sept. 11	135	239	**69-12**	291	**71- 3**	Very vigorous, abundant.
" " J. O. Reilly "No. 1"	" "	"	" 17	25	" 6	Aug. 17	110	180	**30-12**	360	**38-13**	Medium.
" " " "No. 2"	" "	25	" 17	16	" 6	July 28	90	0	....	156	**5- 1**	Very feeble and scanty.
" " " "No. 3"	" "	15	" 17	15	... ...	Aug. 17	110	100	**13·15**	220	**18- 5**	Medium.
" " " "No. 4"	" "	15	" 17	11	....	Aug. 17	110	64	**9-15**	218	**16-12**	Feeble and scanty.
" " " "No. 5"	" "	25	" 15	18	July 2	Aug. 17	110	78	**10- 8**	200	**16-14**	Feeble and scanty.
" " " "No. 6"	" "	26	" 17	18	....	Aug. 17	110	44	**5- 8**	139	**9- 1**	Feeble.
" " M. F. Pierson "No. 10"	" "	"	" 17	22	....	Aug. 16	109	136	**26-11**	309	**33- 2**	Medium.
" " " "No. 88"	" "	"	" 15	26	June 21	Aug. 19	112	300	**79- 9**	385	**83-13**	Very vigorous.
" " " "No. 99"	" "	"	" 17	"	" 21	Aug. 16	109	300	**63-11**	385	**67- 5**	Very vigorous.
" " Pringle and Horseford	" "	9	" 15	8	" 24	Aug. 16	109	237	**57- 7**	363	**68- 3**	Vigorous.
"Wild potato" from Alfred Rose	" "	26	" 18	24	" 26	July 28	90	67	**12- 2**	167	**17- 2**	Medium.

As appears from the table the Buffalo Bill was most productive both in merchantable and total yield; Putman's Junks was second, and Burbank third. Calculating the yield of these per acre, allowing every eye to have grown and 60 pounds to the bushel, the first would have given a fraction over 275 bushels of merchantable tubers; the second a trifle less than 213 bushels, and the third a fraction less than 202 bushels. A rather severe drought in June much retarded the growth of the plants, and doubtless accounts in a measure for the small yield secured.

The Harlequin, and Seedling "No. 2" from J. O. Reilley, yielded no merchantable tubers. The former of these is grown only as a curiosity, having variegated foliage. Strictly speaking, it should not be compared for crop with other varieties, nor should the seedlings of Mr. O'Reilley, as the past season marks only the third year from the seed. The smallest yield from a named variety other than the Harlequin, was from the Giant Osceola; at the rate of only a trifle more than 18 bushels of merchantable tubers per acre.

The marked variations in the yield of different varieties are interesting. But it should be remembered that only those varieties that were planted at the same time, and that matured at the same time are comparable. Even if the soil were uniform, a difference in the date of planting or maturity might expose the varieties to marked changes in climatic conditions.

In the following table is presented another phase of the question of prolificacy. The varieties, 66 in number have all been grown consecutively since 1883, and without a change of seed. In but three of these years, however, viz: 1883, 1884 and 1886, were all grown in such a way as to be strictly comparable for yield with one another. The list is presented in the table for these years, the names being arranged in the order of merchantable yield. In all, the seed used was single eyes, planted in rows three and a half feet apart, the cuttings one foot apart in the row. In 1886, the soil was less highly fertilized than in the other seasons, which is the only difference to be noted.

POTATO—RELATIVE PROLIFICACY OF VARITIES IN DIFFERENT SEASONS.

1886.	First vegetation.	First bloom.	Date when tops were dead.	No. of merchantable tubers.	Weight of merchantable tubers.		Total number of tubers.	Total weight of tubers.		1883	Weight of merchantable tubers.	1884	Weight of merchantable tubers.
					lbs.	oz.		lbs	oz		lbs		lbs
Breese's Red	May 15	July 6	Sept. 22	288	**125**	**14**	369	129	1	White Whipple	189	*Rosy Morn*	129
Rural Blush	" 20	" 6	" 11	238	**107**	**13**	388	118	14	*White Star*	179	*St. Patrick*	121
Baker's Imperial	" 17	June 23	" 8	250	**90**	**3**	312	93	0	*American Giant*	178	Vick's Prize	113
Roger's No. 7	" 15	" 29	" 20	273	**89**	**9**	362	92	13	Rubicund	162	*Rochester Favorite*	112
American Giant	" 18	" 29	Oct. 1	220	**88**	**11**	252	89	10	Grange	161	Dunmore	111
Andrus White Rose	" 15	....	Aug. 31	221	**76**	**10**	354	83	11	Gipsy	158	*Roger's No. 7*	111
St. Patrick	" 17	....	Sept. 11	316	**74**	**0**	336	75	2	Roger's No. 4	154	*American Giant*	110
White Elephant	" 18	June 24	" 1	265	**63**	**9**	352	67	5	*Rural Blush*	154	*Rural Blush*	109
James Vick	" 17	" 18	Aug. 20	223	**63**	**5**	281	66	7	Beauty of Hebron	151	Rocky Mountain Rose	106
Rochester Favorite	" 19	....	Sept. 1	238	**62**	**15**	262	64	3	Adirondack	151	Late Beauty of Hebron	106
Rosy Morn	" 17	June 17	Aug. 20	224	**61**	**6**	368	67	2	Pennsylvania Belle	151	Boston Market	98
Big Benefit	" 18	....	" 30	222	**57**	**1**	330	63	10	New England Beauty	149	White Elephant	96
White Star	" 19	July 3	" 27	246	**56**	**5**	343	59	15	White Elephant	148	Corless Matchless	95
Jumbo	" 17	June 17	" 10	254	**56**	**2**	365	60	15	Crandall's Seedling	145	Early Sunrise	95
Clark's No. 1	" 17	" 23	Sept. 21	195	**55**	**0**	238	57	8	*Rochester Favorite*	141	James Vick	95
White Whipple	" 21	July 6	Aug. 31	279	**52**	**6**	458	65	15	Defiance	137	Grange	93
Chicago Market	" 15	June 21	" 17	252	**52**	**3**	340	100	3	*Roger's No. 7*	134	Roger's No. 4	93
New Champion	" 17	" 23	" 17	177	**47**	**3**	285	52	7	Clark's No. 1	134	Early Rose	89
Boston Market	" 15	" 17	" 18	238	**47**	**1**	331	54	8	Wall's Orange	133	Rose's New Seedling	86
Astonisher	" 17	" 26	" 31	167	**45**	**13**	196	47	2	*New Champion*	130	*New Champion*	86
Early Vermont	" 17	" 21	" 16	191	**43**	**0**	291	47	13	*Rosy Morn*	129	Early Vermont	83
Marvel of Beauty	" 24	July 1	" 19	188	**43**	**0**	254	45	8	*St. Patrick*	128	*White Star*	82

POTATO: RELATIVE PROLIFICACY OF VARIETIES IN DIFFERENT SEASONS (*Continued*).

1886.	First Vegetation.	First bloom.	Date when tops were dead.	Number of merchantable tubers.	Weight of merchantable tubers.		Total number of tubers.	Total weight of tubers.		1883.	Weight of merchantable tubers.	1884.	Weight of merchantable tubers.
					lbs.	oz.		lbs	oz		lbs.		lbs.
Corless Matchless	May 17	June 21	Sept. 9	190	**42**	**9**	267	44	14	Magnum Bonum	125	* Breese's Red	80
Late Beauty of Hebron	" 17	" 17	Aug. 19	227	**40**	**12**	423	50	4	Breese's Red	118	Pennsylvania Belle	80
Bliss No. 12	" 15	" 29	Sept. 1	235	**35**	**10**	457	46	6	* James Vick	115	Marvel of Beauty	79
Rocky Mountain Rose	" 15	" 22	Aug. 21	162	**34**	**8**	312	42	4	Mammoth Pearl	115	Early Ohio	79
Beauty of Hebron	" 17	July 2	" 10	175	**34**	**5**	308	41	10	Baker's Imperial	113	Scottish Champion	75
Grange	" 17	June 24	" 25	172	**33**	**9**	384	44	5	Dunmore	111	Clark's No. 1	72
Pennsylvania Belle	" 17	" 17	" 17	150	**32**	**5**	258	39	11	Luxury	108	*Early Mayflower*	70
Mammoth Pearl	" 17	....	" 17	142	**32**	**3**	238	36	10	Invincible	107	Bliss Triumph	70
Rogers No. 4	" 15	......	Sept. 15	129	**31**	**4**	192	33	10	Chicago Market	104	Magnum Bonum	68
Scottish Champion	" 18	....	" 11	173	**29**	**5**	369	38	11	Conqueror	103	Beauty of Hebron	65
Early Mayflower	" 17	....	Aug. 9	215	**28**	**12**	535	40	8	Corless Matchless	96	White Whipple	65
Dunmore	" 19	....	" 17	160	**28**	**2**	288	33	10	*Early Mayflower*	96	* Gypsy	65
Early Sunrise	" 17	June 17	" 4	165	**25**	**10**	277	29	0	Steele's Red	96	Rubicund	65
Early Electric	" ?	....	" 10	100	**23**	**10**	193	27	11	Late Beauty of Hebron	95	Early Telephone	63
Wall's Orange	" 17	June 29	" 20	130	**23**	**7**	265	31	6	Vick's Prize	92	Chicago Market	63
Early Ohio	" 18	....	July 30	119	**22**	**10**	235	26	8	Boston Market	92	Baker's Imperial	62
Adirondack	" 18	July 2	Aug. 17	165	**21**	**15**	277	27	12	Bliss No. 12	90	Invincible	61
Bliss No. 51	" 17	......	Sept. 1	148	**21**	**14**	300	29	11	Early Sunrise	90	Defiance	60
English Champion	" 17	....	Aug. 10	147	**20**	**0**	358	27	2	Early Snowflake	88	Intermediate	60
Early Snowflake	" 15	......	" 5	168	**19**	**10**	340	25	7	Rocky Mountain Rose	88	New England Beauty	60
Tyrian Purple	" 17	July 5	" 17	133	**18**	**12**	367	24	10	Bliss Triumph	84	Big Benefit	59
Crandall's Seedling	" 17	....	" 9	123	**17**	**12**	231	22	15	Garnet Chili	84	Vermont Champion	58

*Of the varieties enclosed in brackets the yield was the same, POTATO—RELATIVE PROLIFICACY OF VARIETIES IN DIFFERENT SEASONS (*Continued*).

1886.	First Vegetation.	First Bloom.	Date when tops were dead.	Number of merchantable tubers.	Weight of merchantable tubers. lbs.	Weight of merchantable tubers. oz.	Total number of tubers.	Total weight of tubers. lbs	Total weight of tubers. oz	1884.	Weight of merchantable tubers. lbs.	1883.	Weight of merchantable tubers. lbs.
Early Rose	May 17	June 17	July 29	100	**17**	**5**	281	26	11	Marvel of Beauty	82	*Bliss No. 30*	57
Bliss Triumph	" 18	....	Oct. 1	88	**17**	**3**	192	21	13	Early Telephone	82	Early Electric	55
Magnum Bonum	" 17	....	July 30	92	**17**	**3**	133	19	10	Early Vermont	81	Bliss No. 12	51
Rose's New Seedling	" 17	....	Aug. 21	94	**16**	**8**	283	27	8	English Champion	81	Mammoth Pearl	51
Defiance	" 17	....	" 17	142	**16**	**7**	321	18	6	Early Ohio	79	*Pride of America*	49
Vick's Prize	" 17	....	" 16	104	**15**	**14**	458	35	0	Andrus White Rose	75	Conqueror	48
Gipsy	" 18	June 24	" 3	100	**14**	**7**	192	18	10	*First and Best*	73	Jumbo	47
Early Telephone	" 17	....	" 14	100	**13**	**11**	324	22	10	Jumbo	72	Bliss No. 51	46
Conqueror	" 17	....	" 18	71	**13**	**0**	129	15	3	Early Rose	71	Astonisher	46
Pride of America	" 15	....	" 16	84	**11**	**9**	304	21	2	Tyrian Purple	65	Andrus White Rose	42
Bliss No. 30	" 15	....	Sept. 11	76	**11**	**6**	176	13	12	Intermediate	65	Crandall's Seedling	42
Mountain Rose	" 17	....	Aug. 9	67	**7**	**6**	292	16	12	Early Electric	63	Garnet Chili	42
Vermont Champion	" 17	July 2	" 18	48	**7**	**3**	176	12	10	*Pride of America*	56	Adirondack	42
Steele's Red	" 18	....	" 25	59	**7**	**2**	200	12	0	*Mountain Rose*	50	Early Snowflake	36
Intermediate	" 18	....	" 29	57	**6**	**15**	107	9	1	Big Benefit	47	Tyrian Purple	36
Rubicund	" 21	....	" 20	46	**6**	**8**	192	12	11	*Vermont Champion*	47	English Champion	32
Flesh Colored	" 18	July 2	" 21	46	**5**	**12**	139	8	14	*Bliss No. 30*	45	*First and Best*	32
New England Beauty	" 19	....	" 21	36	**4**	**8**	120	9	1	Bliss No. 51	43	Luxury	27
Luxury	" 15	....	" 9	24	**3**	**14**	320	17	10	Rose's New Seedling	43	*Mountain Rose*	23
Invincible	" 18	....	" 9	30	**3**	**14**	126	7	7	Astonisher	38	Scottish Champion	21
Garnet Chili	" 17	June 23	July 30	32	**3**	**10**	100	5	9	Scottish Champion	36	*Flesh Colored*	21
First and Best	" 19	July 2	Aug. 2	13	**1**	**9**	142	7	5	*Flesh Colored*	8	*Vermont Champion*	18

The want of order in the names during the three seasons is certainly conspicuous. As a matter of interest the table is divided into three equal parts of 22 varieties each, and the varieties that come in the same division in the three seasons are printed in italics. It appears that but eight are common to the first part, but one to the second, and but six to the third, while Andrus White Rose, Astonisher and Jumbo, that come in the first part in 1886, are in the third part in 1883 and 1884, and other equally striking incongruities appear. It might almost be said that no regularity exists, and yet the utmost care has been taken to make the conditions of planting and culture equal. Whatever the differences in conditions may have been, they seem to have acted upon the varieties in varying degrees. In view of these results, it should certainly not seem strange that those who send out new seedling potatoes are often embarrassed by conflicting reports from different localities.

WILD POTATOES.

Five samples received as wild potatoes were grown at the Station the past season, though but three of these were clearly distinct.

A few tubers of *Solanum maglia* were received from the Kew Gardens of England. In appearance they very closely resembled small tubers of the common potato. The foliage did not differ much from that of the ordinary potato, except in the remarkable profusion of its blossoms. The flowers appeared about with those of the common potato, but in far greater numbers, and they continued undiminished in abundance until frost destroyed the plants. No fruit formed, however.

The tubers produced were very few in number, as compared with the vigorous foliage. They varied in size from that of a pea to one and a half inches in diameter, and were extremely rough, though the eyes were not deep. The skin of some was nearly white, while in others it was much blotched with purple. They grew at a great depth in the soil, some being found fifteen inches below the surface. The planted tubers were not all decayed at the time of digging.

A wild potato received from Prof. Beal of the Michigan Agricultural College under the name "*Solanum tuberosum* var. *boreale*, or *S. Fendlerii*," resembled the above in some respects, but the foliage was less vigorous, and was much more injured by the beetle. The yield of tubers was better both in number and size, the largest one being two and a half inches long by two in width. The eyes were rather deep and the skin pure white. On the whole, they showed no characters that would have distinguished them from the small tubers of many varieties of the common potato. Prof. Beal states that at the College this species yielded seed balls. It did not do so at the Station, a result which may have been due to injury from the beetle.

A third came indirectly from Mr. Alfred Rose. If this is a wild potato at all, it is probably identical with the above. Neither the foliage nor the tubers distinguished it from the common potato, and the yield, though small, was not less than that of some varieties of the latter.

A second wild potato from Prof. Beal, and one from Mr. T. H. Betts, of Cropseyville, N. Y., proved to be the *Solanum Jamesii*, the same as the one grown at the Station since 1883.

Tubers of this species grown in 1884 were found to be sound last spring (1886), and were planted as an experiment. They vegetated shortly earlier than others of the same species grown in 1885, and planted at the same time.

ATTEMPTS AT CROSS FERTILIZATION.

Many attempts were made to secure a cross between the *Solanum maglia* and the common potato, the pollen being repeatedly applied in both directions, but without success. Flowers of the White Star, fertilized with pollen from *S. maglia* produced rudimentary fruits, but these invariably dropped off when they had grown to the size of a pea. It is hoped that our efforts may succeed the coming season.

EXPERIMENTS WITH TUBERS FROM PRODUCTIVE AND UNPRODUCTIVE HILLS.

An extensive plat test with tubers selected in the fall of 1885 from the most productive and least productive hills was planned. The plats were planted at the proper time in accordance with the plan, but a severe drought followed, and on many of the plats the plants were so stunted that they never recovered. The crop was so nearly a failure as to be valueless for the purpose intended. Unfortunately also, the potato rot was so severe in the fall of 1885 as to break up, for the most part, the series of selections that had been followed through 1884 and 1885. In very many cases the largest hills in the rows were totally destroyed, and hence the selecting could not be continued. But little can be reported, therefore, upon this promising line of experiment. The largest and smallest hills were saved from only two of the ten varieties grown from productive and unproductive hills in 1885, viz., the Adirondack and Rural Blush. The largest and smallest tuber that survived the rot from both the best and poorest hills of these varieties were cut to single eyes and planted as described in our reports for 1884 and 1885*, the planting being done April 30.

The yields calculated per eye in ounces, were as follows:

POTATO—SEED TUBERS FROM PRODUCTIVE AND UNPRODUCTIVE HILLS.

	From Largest Hill.				From Smallest Hill.			
	Largest tuber.		Smallest tuber.		Largest tuber.		Smallest tuber.	
The yields are calculated *per eye* in ounces.	Merchantable.	Total yield.	Merchantable.	Total yield.	Merchantable.	Total yield.	Merchantable.	Total yield.
Adirondack	9.33	9.47	15.45	15.55	8.00	9.16	8.20	8.62
Rural Blush	13.53	13.67	16.25	16.58	19.03	19.44	0.08	0.11

	LARGEST HILL. Av of the two tubers.	SMALLEST HILL. Av. of the two tubers.
Adirondack	11.52	8.09
Rural Blush	14.62	11.75

It is evident from the table that the results are less uniform than were those of the same experiment in the previous two seasons, and in some respects appear to contradict the hypothesis that has been so well sustained. The largest yield secured comes from the smallest hill, while in two out of four cases, the smallest tuber yielded more than the largest. Taking the average of the two tubers of each hill, however, the results are clearly in favor of the largest hills in both varieties. It should be remembered, that in some cases in this planting, the largest tuber was lost by decay. This experiment adds nothing to the testimony of 1884 and 1885. It is presented only for the purpose of making the report of results complete.

For experiments in this line next season, the largest and smallest hills from 124 varieties and seedlings of the potato have been selected; beside sufficient seed of the White Star variety to plant many field plats. It is to be hoped, therefore, that the results of 1887 in this line, may be considered as conclusive.

IS CUTTING THE TUBER, IN ITSELF, DETRIMENTAL?

In the majority of our experiments made with large and small tubers, the yield has been largest from the former.

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*See Report New York Agricultural Experiment Station, 1884, pp. 301-305; 1885, pp. 204-207.

If, then, in a given experiment, we find that the yield of cuttings taken from large tubers is less than from whole tubers of the same weight as the cuttings, the inference is warrantable that the cutting of the tuber was in some degree detrimental to the crop.

On April 27, two rows, each 66 feet long, were planted with single eyes of the White Star potato cut from large tubers, and two adjoining rows of the same length were planted with small whole tubers, of which the average weight was exactly the same as of the single eyes. The selections were made by first weighing the required number of single eyes, and then counting out the same number of small tubers, changing the individual tubers until the desired weight was secured.

In the same manner, two rows were planted with two-eye cuttings, and the two adjoining rows with whole tubers of the same average weight; two rows with three-eye cuttings, and the two adjoining with whole tubers as before. The rows were 3 feet 10 inches apart, the tubers or cuttings one foot apart in the row. Ordinary cultivation was given.

The yields secured were as follows:

POTATO.

The yield of Cuttings as compared with that of whole tubers of the same weight.

	Number of row.	Plants in row.	Yield of row—merchantable.	Yield of row—total.	Yield of the two rows—merch.	Yield of the two rows—total.
			lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
Single eyes.......	1	64	33– 8	39–12	68 - 8	83– 0
	2	61	35 - 0	43– 4		
Small tubers	3	66	40 0	54– 8	72– 0	103– 8
	4	65	32– 0	49– 0		
2-eye cuttings	5	64	45 0	53– 0	81– 8	104– 0
	6	66	36– 8	51– 0		
Whole tubers.....	7	66	49– 0	62– 8	98– 8	129– 8
	8	66	49– 8	67– 0		
3-eye cuttiugs	9	65	50– 0	62– 8	97– 8	115– 0
	10	65	47– 8	52– 8		
Whole tubers.....	11	63	52– 8	62– 0	101– 0	121– 0
	12	64	48– 8	59– 0		

From the table it appears that the individual rows showed considerable fluctuations in yield, but that when the yields of the various duplicate rows were added together, the figures are clearly in favor of the whole tubers. The number of plants in the various rows, though not quite uniform, fluctuated so little that the yields, calculated to full stand, would not differ materially from those given in the table.

Adding together the yields of the six rows of cuttings, and of those of the whole tubers, and calculating the yield per hundred plants, we have :

	Merchantable.	Total.
Yield per hundred plants—cuttings.........	64 lbs. 5 ozs.	78 lbs. 7 ozs.
" " " " —whole tubers.....	69 lbs. 10 ozs.	91 lbs. 2 ozs.

showing a very perceptible difference in favor of the whole tubers.

IS ANY DEGREE OF DRYING OF THE CUTTINGS BEFORE PLANTING BENEFICIAL ?

It has often been stated that if potato cuttings are exposed to the air a few days before planting they will vegetate with more vigor than those planted as soon as cut.

In order to test this question, a few White Star tubers were cut to single eyes on April 19, and spread on the floor of the office attached to the greenhouse. On April 30, a few more tubers of the same variety were cut to single eyes, and two short rows (52 eyes) of these, with the same number of the dried cuttings were planted. At this time the dried cuttings had lost about 14 per cent. of their original weight by evaporation, or approximately one-fifth of the water that they contained when cut.

No especial difference was noted in the time of vegetation of the cuttings in the different rows, nor in the growth of the plants, with the exception that the tops from the dried cuttings died about five days later.

The yields were as follows :

			Calculated to 100 plants.	
	Merchantable.	Total.	Merchantable.	Total.
Fresh Cuttings—52 plants yielded....	18 lbs. 10 oz.	23 lbs. 7 oz.	35 lbs. 13 oz.	45 lbs. 1 oz
Dried Cuttings—48 plants yielded....	21 lbs. 8¾ oz.	25 lbs. 1½ oz.	44 lbs. 14 oz.	52 lbs. 4 oz

The slightly smaller vegetation of the dried cuttings cannot strictly be ascribed to the drying, because in many rows planted in the vicinity the same day, with fresh cuttings, the vegetation was no greater, and in some instances decidedly less than in this case. As the rows grew side by side, the differences in yield can hardly be ascribed to soil, and the only logical inference appears to be that under the conditions, the drying of the cuttings was favorable to yield.

The deductions to be made from the two experiments just noted are:

1st. That by cutting large tubers for seed, we lose the advantage of large size, and perhaps more, through the detrimental influence of the cutting. At least this inference is warrantable when the cuttings are planted as soon as cut.

2nd. If cutting is to be practiced, it is advantageous to expose the pieces for a time to the air before planting.

The reasons for the results obtained are not clear in either case. The skin of the tuber furnishes a very great protection against loss by evaporation, as was shown by a series of experiments. In one case a cut tuber placed on the mantel in the office lost more than 25 per cent. of its weight in the time that a whole one lost but about one per cent. In another case a cut tuber lost more than 43 per cent., while a whole one lost less than one. Whole tubers, and those cut in varying degrees placed in a box of dry earth lost in weight in proportion to the amount of cut surface exposed. But this solution is hardly applicable to the present case, because during the period of vegetation (about 20 days) one and a half inches of rain fell, coming on five different days, and hence there could hardly have been a dearth of moisture in the soil. We do not know how much the plant depends upon the seed tuber or cutting after it has started into growth. During the latter part of May and the first half of June, the soil became very dry at times, and it is possible that during this period the effect of the cutting proved injurious.

So, in the second experiment, the influence of the drying does not seem to have been exerted during the period of vegetation, because the dried cuttings did not vegetate earlier than the fresh ones. The starting of the eyes does not appear to be favored by drying, at least not in the spring, because it was noted that potatoes stored in the cellar in bags during the winter where the moisture was sufficient to decay the bags, were decidedly more sprouted at planting time than others stored in a comparatively dry room. The subject is one of interest, and merits further investigation.

DO POTATOES GROW MORE REGULAR IN FORM WHEN ONLY WELL FORMED TUBERS ARE USED FOR SEED?

This is a question of considerable importance to the potato grower. The answer, however, may depend upon several conditions. So far as the cause of mal-formed tubers is due to inheritance, it may doubtless be lessened by selection. But if the irregularity is the result of soil or season, selection can avail little. That the cause of rough potatoes is partially due to the soil is indicated by the fact that the tubers of a given variety are usually smoother when grown on sandy soil than on that which is hard or stony. The knobs or prongs so often found on potatoes are believed by many to be due to a second growth taking place on the advent of rain, after a period of severe drought, and it is thought in such cases the starch largely passes from the parent tuber into the prongs, much injuring the quality of the former.

It is well known on the other hand that form is an inherited character in the potato, because each variety has its own shape.

April 29 three short rows were planted with single eye cuttings made from the very roughest and most mal-formed tubers that could be selected, and three adjoining rows from the smoothest and most regular samples. The variety was the White Star. The crop was harvested Oct. 1 with the following result:

The three rows grown from mal-formed tubers yielded 665 tubers, of which 203, or about 30 per cent., were more or less mal-formed.

The three rows grown from the smooth potatoes yielded 578 tubers, of which 164, or rather more than 28 per cent., were more or less mal-formed, showing that selection in this case exercised no material influence.

WHEN DO THE TUBERS CEASE TO ENLARGE?

The question as to the stage of growth in the potato plant at which the tubers cease to grow larger, is one of some importance to the farmer, as it is sometimes desirable to dig a crop before the tops are entirely dead. In order to answer this question, if possible, on August 27 the soil was removed from several hills of potatoes sufficiently to expose one tuber in each, and of this the diameter was carefully noted, after which the soil was replaced. The hills examined were of varying degrees of maturity. After the tops were entirely dead, the same tubers were measured again, with the following results:

Of ten tubers averaging 1 3-4 inches in diameter, of which the tops showed the first stages of ripeness, as indicated by the blackening or yellowing of some of the leaves, four showed a slight increase in size. One had gained in diameter 1-4 of an inch, two 1-8, and one 1-16 of an inch.

Of five tubers averaging 1 5-8 inches in diameter, of which the tops had unquestionably commenced to die, but were still quite green, only one showed any gain, and that but 1-8 of an inch in diameter.

On August 27 one very small tuber was measured on a plant that was apparently just beginning to die. At this time it was 1-8 of an inch in diameter. September 13 this tuber was measured again, and was then 5-16 of an inch in diameter. The tops were still not entirely dead, but nearly so. September 27 this tuber had grown to 3-8 of an inch in diameter, showing that the growth continued until complete death of the tops.

From these observations, we may infer that after the tops have commenced to die, no appreciable growth will take place in the tubers that are of merchantable size ; but that the youngest tubers may continue to increase slightly until complete death of the foliage.

WHAT BECOMES OF THE PLANTED TUBER OR CUTTING?

An experiment conducted during the winter of 1884-5* in the green house, showed that the greater part of the stored nutriment of the planted tuber was consumed by the growing plant before the tops died. Another made in the garden during the summer of 1885† showed that this nutriment is not necessary to the development of the plant after the latter is once established, and that under favorable conditions, as good a crop is produced without this patrimony as with it.

The question as to how far this stored nutriment may serve as an offset to fertilizers in the soil has a practical bearing. It would seem natural to assume that the less nutriment the soil affords the greater use would be made of that contained in the tuber, and the results secured in 1884-5* in the greenhouse experiment seemed to warrant such a conclusion. In order to investigate this subject further, the following experiment was planned :

On May 3, twenty large White Star tubers were selected, and the weight of each noted in grammes. Ten of these were then planted in a part of the farm where the soil was known to be very poor, and the remaining ten in a highly fertilized part of the garden. From time to time during the growing season the seed tuber was removed from a hill in each lot, and the dry matter in it determined ; and in some cases the entire hill was taken, and the tops and young tubers weighed, in addition to determining the dry matter in the seed tuber. A portion of the hills was left undisturbed in order to compare the yield of these with that of the hills from which the seed tuber was removed.

The results appear in the following table.

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*See report New York Agricultural Experiment Station for 1885, p. 207.

†L. C. P. 209.

THE ABSORPTION OF THE SEED TUBER ON POOR AND RICH SOIL.

POOR SOIL.								RICH SOIL.							
No.	Weight when planted.	Calculated dry matter when planted.*	Date when dug	Dry weight when dug.	Loss of dry matter.	Yield of tops and tuber.	Yield of tuber when ripe.	No.	Weight when planted.	Calculated dry matter when planted.	Date when dug	Dry weight when dug.	Loss of dry matter.	Yield of tops and tubers.	Yield of tubers when ripe.
	grammes	grammes		grammes	grammes	grammes	lbs. ozs.		grammes	grammes		grammes	grammes	grammes	lbs. ozs.
1	205.6	44.39	June 14	26.4	17.99	84	....	11	186.7	40.31	June 14	13.4	26.91	412.8	....
2	159.7	34.09	" 19	14.2	19.89	....	0–15¾	12	302.5	65.31	" 19	18	47.31	....	5– 0¾
3	252.5	54.51	" 28	18.1	36.41	330.3	....	13	287.6	62.09	" 28	10.3	51.79	734.4	....
4	194.7	40.03	July 2	12.1	27.93	....	2– 0¾	14	418.8	90.42	July 2	35.7	54.72	....	4–11¼
5	180.2	38.91	" 10	7.7	31.21	288.2	....	15	364.4	Seed	tuber	decaying	July 10	....	....
6	177.2	38.25	" 22	7.4	30.85	....	2–1	16	226.2	....	....	....	....	....	5–14
7	190.7	41.16	Aug. 2	5.7	35.46	539.8	....	17	196.7	Seed	tuber	decaying	July 10	....	....
8	166.2	....	....	....	....	....	1–10¼	18	289.2	62.44	July 10	16	46.44	428.8	....
9	279.4	....	....	....	....	....	1–13¼	19	146.4	Seed	tuber	decaying	July 10	....	....
10	389	....	....	....	....	....	2 3¼	20	175.8	....	....	....	....	....	5– 4½

*The average dry matter of 5 samples of potato dried in the spring of 1886 was 21.59 per cent. In calculating the dry matter in the tubers planted, it was assumed that they contained the same percentage.

In plants Nos. 2, 4, 6, 12 and 14, the seed tuber was removed on the dates noted, leaving the tops and roots in place as far as possible. Nos. 1, 3, 5, 7, 11, 13 and 18 were dug on the dates noted, and the weights of the tops and tubers noted. Of all these hills, the dry matter in the seed tuber was determined as soon as the latter was dug. Nos. 15, 17 and 19 were examined on July 10, but the seed tubers were found to be decaying. The remaining hills were left undisturbed until the tops had died.

The column showing the loss of dry matter from the different tubers indicates that the amount of loss was not proportional to the time the tuber remained in the soil. Neither does it appear to depend much upon the weight of the tuber. It should be noted with reference to plant No. 18, that the tuber appeared slightly shrivelled when dug, being different in this respect from any of the others. It is possible that it was not in a normal condition.

It is of interest that the loss in the tubers planted on the rich soil is decidedly greater on the same dates than in those on the poor soil. From the following table it appears that a given loss of dry matter from the tubers in the rich soil was accompanied by a much larger development of tops and young tubers than the same loss from those in the poor soil. Thus in tubers 11, 13 and 18 on the rich soil, and 1, 3 and 5 on the poor soil, which were dug on corresponding dates, if we compute the weight of the tops and young tubers that would have been produced at the same rates, by a loss of 100 grammes of dry matter from each tuber, we have :

RICH SOIL.	POOR SOIL.
Tuber No. 11, 1432.2 grammes.	Tuber No 1, 466. grammes.
" " 13, 1417.7 "	" " 3, 910.3 "
" " 18, 924.1 "	" " 5, 923.1 "

It is of interest, also, that the tubers commenced to decay first on the rich soil. There is some evidence that decay does not take place in healthy planted tubers until the nutriment is entirely exhausted. Thus, tuber No. 6, removed from the plant July 22, though apparently entirely sound, showed no signs of containing starch when examined under the microscope, and only the slightest trace when treated with iodine. Tuber No. 7, dug Aug. 2, showed no signs of decay except at a single point, where it was slightly soft. On cutting it was found to be in a state of disintegration in the part near the terminal end. The central portion was of a yellowish transulcent appearance, and the cells were largely broken down, yet no offensive odor was perceptible. As appears from the table, more than 86 per cent. of the dry matter had passed out of this tuber. In support of this view may be added the fact that when potatoes are planted on poor dry soil, where the tops make but a feeble growth, the seed tuber is frequently found to be quite sound, even when the tops are nearly or quite dead.

The yields of the plants that were permitted to mature, as given in the table, are too few in number to have much value, but they do not show that any material loss followed the removal of the seed tubers. This corresponds with the results secured in 1885.[1]

From these results we may infer :

1st. That although the stored nutriment of the planted tuber or cutting is nearly or quite all consumed by the growing plant, the experiment does not show that this nutriment is more available than any other equal quantity of fertility in the soil. Otherwise, the tubers planted in the poor soil would hardly have yielded up their nutriment less rapidly than those in the rich soil, because we may fairly assume that there was a greater demand for this nutriment in the poor soil.

2nd. The stronger the growth of the plant, the more rapidly does the tuber yield up its nutriment.

3rd. On poor, dry, or badly prepared soil, the nutriment of the tuber cannot recompense for the unfavorable conditions.

If these inferences are correct, it would appear that the chief value of large tubers or cuttings for seed, as contrasted with small ones, lies in the greater vigor that they give to the starting shoot.

OBSERVATIONS ON ROOT GROWTH.

From the botanists' standpoint, roots, like all other parts of the plant, have been quite thoroughly studied. But the subject of the relations of root growth to the processes of agriculture and tillage has received less attention than its importance would seem to merit. It is on the agricultural side only, that the work upon the examination of roots followed at the Station during the past three seasons can claim novelty.

The roots of seven species of garden plants not heretofore examined at the station have been washed out in 1886 for the purpose of making the descriptive notes begun in 1884, and continued in 1885, more nearly complete.[2] In addition, the roots of two species washed out in 1884 have been again examined for the purpose of verifying and supplementing the notes then made. Several experiments intended to add to our knowledge of root growth have also been carried on, some of which are reported.

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[1] See report of N. Y. Agricultural Experiment Station, 1885, p. 209.

[2] See report of N. Y. Agricultural Experiment Station, 1884, pp. 305–315, and 1885, pp. 234–239.

The soil on which the vegetables examined were grown is a fertile clay loam to the depth of six to ten inches, resting on a tenacious subsoil of gravelly clay.

BEAN.

In a plant of the Scarlet Runner bean, of which the roots were washed out Aug. 13, the deeper roots extended to the depth of two and a half feet, and the longer horizontal ones a distance of at least four feet. A few roots grew within one inch of the surface, but the great majority were between two and eight inches deep. At the time of the examination, the plant was in full bloom, and the stems were about four feet high.

It thus appears that the root system was fully as extensive as the part above ground, if not more so. The long distance to which the horizontal roots reach indicate that except on very rich ground it would hardly be wise to place the hills nearer than four feet apart each way. Even at this distance, the roots would extend from one hill quite to the next, so that the soil would be occupied by the roots of two hills at the same time. It also appears that cultivation late in summer, that extended more than two inches deep, would sever many of the roots.

In a plant of Boston Dwarf Wax bean, washed out the same day as the above, the deeper roots were traced to the depth of two feet, and the horizontal ones extended quite as far on either side. The root system was very similar in kind to that of the Scarlet Runner, but decidedly less extensive. The plant examined was approaching maturity.

CORN SALAD.

In a plant of Corn Salad, or Fetticus, of which the roots were washed out August 13, the root system was found to be different in some respects from that of any other plant examined. It appeared to be as concentrated as that of the onion, but unlike that in the almost infinite number of the ub-divisions of the fibers. It was clearly a tap rooted plant, but the tap root was soon lost in its numerous subdivisions. The roots as they left the crown of the plant were both numerous and slender, and they continually divided and sub-divided until a hair-like mat was the result.

The roots appeared to extend in no direction further than one foot, and the greater part of the fibers lay at an angle of about 45 degrees.

The roots of this plant differed from those of any other that I have examined by the fact that they almost always divided into two parts of equal size, whereas in others the branches have rarely if ever equaled in size the root whence they proceeded.

Unlike the onion, the Corn Salad does not appear to demand an excessively fertile soil. It is probable that this plant will thrive as well with the rows one foot apart as at a greater distance.

EGG PLANT.

The egg plant being a native of the tropics, it was rather expected to find a large development of roots very near the surface. Such was not the case, however. In a plant of the Black Pekin variety, of which the roots were washed out Sept. 28, the main roots radiated from the base of the stem at varying angles, but the majority rather inclined to perpendicular. The horizontal roots were smaller in size than those that grew downward, and none reached a greater length than two feet. Branches were most numerous near the base of the stem. The main roots were about the size of a wheat straw. Root hairs were numerous on the fibers.

The plant examined grew but about fifteen feet from a Norway Spruce hedge, and the soil at the time the examination was made seemed dryer here than in the part of the garden not adjacent to the hedge. Possibly the dryness of the soil induced by the hedge may have had some influence upon the root development.

OKRA.

The okra, also a tropical plant, was not found to be especially shallow rooting. In a plant of the dwarf variety of which the roots were washed out Sept. 11, the longer roots extended several inches into the compact clay subsoil. At the depth of eighteen inches the tap root branched freely, and some of the branches were of considerable length, with many sub-divisions. Sometimes these deep branch roots enlarged after leaving the tap root, as did the more shallow ones. A horizontal root was traced a distance of three feet, where it was still the size of a straw of timothy. The fibrous roots chiefly lay at a depth of three to six inches, but many branches reached upward to the surface.

PARSLEY.

In this plant the root system was found to be extensive, and, especially, deep. On Sept. 17 the roots of a plant of the Common Curled, and one of the Hamburg, or turnip-rooted variety, were washed out. Little difference appeared in the roots of the two sorts. In each the tap root was traced to the depth of two and a half feet without coming to the end. At this depth the horizontal branches were frequent, being little if any more than half an inch apart. At the depth of eighteen inches, the soil was pretty well filled with fibrous roots. The branches usually left the tap root in a horizontal direction, and not infrequently grew slightly upward. At the depth of four inches below the surface, a horizontal root was traced a distance of two and a half feet. Many fibrous branches came to the surface.

The feeding ground of this plant appears to extend decidedly deeper than that of most other garden plants, and the roots reach horizontally a considerable distance. In books upon gardening it is usually recommended to plant parsley closely. For the garnishing sorts this is probably best, as a large leaf growth is less desired than a compact tuft of small leaves. For the Hamburg variety, it would doubtless be best to give the plants abundant room.

SQUASH.

The roots of this vegetable were examined with considerable interest, because it has been often stated that they extend as far as the runners. Observations showed that this view is based upon fact; indeed in the bush varieties, the roots extended much further than the stems. In a plant of the Yellow Scallop Bush squash, examined Sept 8, a root was traced horizontally a distance of eight and a half feet without reaching the end, while the longest runners extended but about four feet. This long root grew almost its whole length within three inches of the surface. In a plant of the Hubbard squash, of which the roots were washed out Sept. 11, one of them was traced horizontally a distance of ten feet from the base, and at this point it was an eighth of an inch in diameter, or about a third of its thickness at the start. It might doubtless have been followed much farther, but was accidentally broken at this point, and the remainder could not be distinguished among many other roots. This long root grew at a depth of two to five inches below the surface. It frequently changed its course, but pursued in general a rather straight line. It put out branches throughout its length, some of which were an eighth of an inch in diameter. The number of branches in the ten feet was 385, or on the average 38.5 per foot.

This gives some idea of the enormous extent of the root development of the squash. How many main roots from a single plant extended as far as the one followed I do not know, but several started at the base. Pres. Clark, formerly of the Massachusetts Agricultural College, estimated that the aggregate length of the roots of a squash vine grown under glass amounted to more than fifteen miles, and our results obtained in the open garden, in the absence of specially favorable conditions indicate that this enormous development may be far from improbable.

TURNIP.

The roots of a plant of the Purple-Top Globe turnip were washed out Oct. 29. The root weighed three pounds, and the foliage was very vigorous, but the scanty root development was a matter of surprise. The deepest root appeared to extend no more than eighteen inches, and the longest horizontal roots reached no further. The tap root tapered rapidly from the bottom of the bulb for a distance of six inches, where it divided into two branches, each about a sixteenth of an inch in diameter. Only thirteen branches left the tap root that were as thick as a cambric needle, and but few smaller ones. These branch roots did not subdivide as rapidly as in most other plants examined.

It is well known that the turnip contains less solid matter than other garden roots. Its growth is chiefly made during the cool and moist weather of autumn, when there is little dearth of moisture in the soil, and it stores up very little nourishment. In consideration of these facts, an extensive root system is perhaps not to be expected.

The plants of Muskmelon and Onion, of which the roots were examined in 1884, were both rather dwarfed specimens. The root systems of full grown plants of these were therefore examined again, in order to supplement the notes then made.

MUSKMELON.

The roots of a plant of the Montreal Nutmeg were washed out Sept. 7. The tap root extended perpendicularly but about four inches, when it turned nearly at right angles, descending only gradually as it progressed. The main horizontal roots lay two or three inches below the surface, and one of these was traced to a distance of five feet from the base of the plant, which is further than any of the runners extended. One root ran horizontally a distance of fifteen inches, when it suddenly turned downward, and was followed for fully two feet. At the depth of twenty inches, it branched much in the compact clay.

ONION.

In order to learn how extensive is the root system in the young plant, the roots of a sample of the Large Red onion were washed out on June 21. At this time the leaves were but eight inches long, and the young bulb only the size of a cherry pit, but the roots were found to extend to the depth of sixteen inches.

On September 11, several full grown plants in the same row were again examined. The greater part of the roots extended no deeper than was noted in June. In a few cases, samples were traced to the depth of eighteen inches. No horizontal ones could be traced further than one foot. The roots radiated from the base of the bulb in all directions below horizontal, some lying no more than an inch beneath the surface. They were of equal size throughout their length, except that they were slightly swollen close to the terminus. New roots appeared to be growing, as some were decidedly shorter than the others. As noted in 1884, the branches were all short and never sub-divided.

A careful examination with the microscope of several of the fine fibers revealed no root hairs.

An observation on an onion plant grown under unusual conditions is of interest here. On May 15, seeds of the onion were planted in a three inch drain tile, set in the earth its full length, and which was supposed to have been filled with soil to the bottom. It was frequently noted during the summer that the plant made a poorer growth than many other vegetables which were also growing in drain tiles. On washing out the roots, September 11, it was found that by mistake, only the upper six inches of the tile had been filled with soil, leaving the lower eight inches empty. The roots of the onion grew to the bottom of the soil, when many followed down the inner surface of the tile to the ground beneath. The roots thus attached to the tile were abundantly clothed with root hairs, and the branches here frequently sub-divided. This indicates that the character of the root growth, in the onion at least, may depend to a considerable extent upon conditions.

In order to note whether the root growth in this plant the second year differs from that of the first, the roots of a plant of which the full grown bulb was planted out in the spring were washed out June 10. The system was the same in general, as that of the first year. An estimate made it probable that the plant had formed at least 400 feet of roots and root branches, though it had been set out but about forty days.

IS THE SEASON OF MATURITY OF DIFFERENT VARIETIES OF THE SAME PLANT GOVERNED AT ALL BY THE DEPTH OF THE ROOTS?

The question arose whether one cause of early maturity in certain varieties may not be due to the roots taking their nourishment in shallower, and hence warmer, soil than later varieties. Several observations failed to confirm such an hypothesis. In the beet and radish, an early variety appeared to root shallower than a later one. In the carrot the difference was less marked. In the lettuce and pea, no difference was observed, while in corn, the later varieties rooted decidedly shallower than the earlier ones.

THE INFLUENCE OF ROOT PRUNING ON ROOT GROWTH.

Market gardeners find transplanting young plants of cabbage, tomato, etc., while growing in the cold frame, to be of great advantage in assisting them to endure the final removal to the open ground. The question arose as to the cause of the benefit thus ascribed to a process that would appear to be in itself detrimental.

An experiment made during the spring with cabbage and tomato plants indicated that the benefit chiefly arises from the longer roots being broken in transplanting, which causes a compact growth of fibres near the base of the plant. This mat of fine roots carries the inclosed soil with it in the final transplanting, and thus many of the feeding parts are in a condition to commence absorption at once in their new home. The experiments showed that precisely the same result may be secured by sowing the seeds thinly in the frame, and then severely root pruning the young plants from time to time, taking care to preserve favorable conditions for growth.

Whether this checking of the root growth by transplanting, or root pruning, is, in itself, beneficial or otherwise, in its after effects upon the growth of the plant, is a question which I endeavored to settle by experiment, but upon which the results were only partially satisfactory. In experiments with young plants of cabbage and corn, root pruning seemed to increase the proportionate development of the root as compared to that of the top, but on the whole, to retard growth. In two experiments made in the open ground with corn plants, one indicated that any interference with the roots may be prejudicial to the growth of the plant, while the other showed a slight increase in growth following a single moderate root pruning, but a decided retardation following a second cutting of the roots. In every case, where the root pruning was performed in dry weather, the results appeared injurious to growth. The subject is one of importance, as it lies at the basis of culture in in our hoed crops. We know that a thorough preparation of the soil before planting, and a pulverized surface during the growing season are beneficial. The effects of lacerating the roots in the soil during the growth of the plants are not however so well understood as they should be. It is hoped that the experiments the coming season may give more light upon this question.

HOW FAR DOES SPECIAL TREATMENT OF THE SOIL AFFECT THE DISTRIBUTION OF ROOTS?

As a partial reply to this question, the results of three experiments are noted.

1st. The popular opinion that mulching the surface tends to bring the roots upward was found to be correct so far as the fibrous roots are concerned. That is to say, the proportion of fibrous roots in the first two inches of soil was unquestionably greater in the plants examined in mulched than unmulched rows. No other difference in the root growth was discernible. The observation was limited to the beet and carrot, the varieties of the former being Philadelphia Early Turnip and Early Blood Red, and of the latter Blunt Rooted Early Scarlet Horn. The seeds were planted April 20, and the mulching, which was of straw, was applied June 22 to the depth of two inches.

2nd. Three small experiment plats were planted with potatoes. In the first, the tubers were covered with three inches of sand, in the second with the same depth of common garden soil, and the third with the same depth of a mixture of sand and soil. Some difference was observable in the root growth. In the plat covered with the sand, the roots almost all grew out above the tuber-bearing stems, while in the other two plats they grew out at the same nodes with them. The roots were also larger in size, but branched less in the plat covered with the sand than in the others. The root growth in the plat covered with a mixture of sand and soil differed from the others in the direction of its leading shoots. In this plat the main roots, instead of running horizontally as in the other plats, grew downward at an angle of nearly forty-five degrees, and the branches almost all tended downward. The fibres reached nearest the surface in the plat covered with soil; but the main roots were rather more shallow in the one covered with sand.

Why the roots should have inclined downward more in the plat covered with a mixture of sand and soil than when the sand or soil was used alone does not appear.

3rd. Several plants were grown in three inch drain tiles, set full length in the earth, with the bottom open, and the space within filled with garden soil. Plants of bean, cabbage, corn, egg-plant, tomato and watermelon made a fair or good growth, and in every case, the roots were found to have penetrated to the bottom of the tile, when a portion of them turned upward, growing in this direction until within three to six inches of the surface, where they grew horizontally in the usual manner. Other roots entered the soil beneath the bottom of the tile but did not grow upward. It was observed in those that grew upward that they branched more and more as they approached the surface.

Plants of lettuce, pepper and strawberry-tomato (Physalis), grown in tiles made a poor growth, and on washing out the roots, it was found that the roots had not grown upward as in the other plants, though in the pepper they had started in that direction.

From these observations it appears that the distribution of roots may be influenced to some degree by treatment of the soil, but that compelling them to grow deep, as in the tiles did not in the majority of cases prevent them from rising at last to the more fertile and mellow soil near the surface.

It would appear from other observations that the direction assumed by roots in the soil is governed as much by circumstances as by an inherited tendency to grow in a particular manner. This view is strengthened by the fact that a plant of barley set in the bottom of a suspended flower pot, the stem passing downward through the drainage hole, filled the soil in the pot with roots, some of which protruded at the upper surface. An examination of the roots showed that the growth was apparently exactly similar to that formed when the plant is set in the pot in its natural position. It was also observed in a plant of potato growing under a bell-glass where the moisture exhaled from the leaves was all confined, that the rootlets which started from almost every node of the stem as often inclined upward as downward.

Botanists tell us that a certain degree of warmth, moisture, and oxygen are indispensable to the development of roots, and that when these are present, the rapidity of growth and the number of the branches are dependent upon the amount of available plant food. In that stratum of the soil in which the balance of these four conditions is on the whole most favorable to root growth, the roots develop fastest, and this is doubtless one law that governs their distribution.

THE NEARNESS OF FIBROUS ROOTS TO THE SURFACE OF THE SOIL.

In almost all the examinations of roots, the nearness to which the fibres approach to the surface was remarked. On Aug. 11 the soil between two rows of sweet corn was examined with special reference to this subject, and the roots were found to be numerous within an inch of the surface. An examination with the microscope showed that these shallow roots were clothed with live root-hairs, which shows that they were then active. On Aug. 14 the soil was examined on the south side of a plat of a tall growing, southern corn—the point most fully exposed to the sun's rays. At the depth of half an inch, a root the size of a stalk of timothy grass left the stem, and proceeded directly towards the south, giving off numerous branches and continuing at this depth for a considerable distance, or as far as traced. In plants of tobacco examined the same day, roots were found almost to protrude from the soil. In very many instances during the washing out of roots it was remarked that fibres proceeded upward from the main horizontal roots, nearly or quite to the surface of the ground.

GENERAL OBSERVATIONS.

From the study of roots carried on during the past three seasons, it seems possible to make two generalizations applicable to plants grown at the Station.

1st. The chief feeding ground of the roots of our hoed crops, including those of both field and garden, is in the stratum of soil lying from three to ten inches below the surface. Several plants, particularly the Leguminosæ, the cabbage family, lettuce, parsley, parsnip, beet, and perhaps a few others, doubtless obtain a considerable amount of their nourishment below ten inches, but judging from the locality in which the fibrous roots are most numerous, we may infer that even these secure more of their food above than below that depth.

2nd. In general terms, the plants that make the largest development of stem and foliage during summer, as corn, sorghum, tobacco and the Cucurbitæ, are those of which the feeding ground is shallowest in the soil.

THE ORCHARD.

The winter of 1885–6 proved disastrous to young trees of the more tender fruits. Eleven out of thirty peach trees, six out of fifteen nectarine, and six out of nineteen apricot trees were destroyed. Each of the trees represents a variety. The greater part of those killed were reset last spring.

It is proposed to head a portion of the trees of these fruits low in the future, and to make the experiment of protecting them through the winter by placing stalks of tall corn or sorghum about them late in autumn.

The apples grafted in the spring of 1883 have made a good growth, with three exceptions. The Sweet Bough, Blenheim Pippin and Hubbardston were found to be nearly or quite dead last spring and were therefore reset.

The apple crop was a general failure in this section the past season, though the trees blossomed nearly as well as usual. Of the varieties grafted in 1883, eight of the thirteen summer sorts, eleven of the twenty-two autumn, and twenty-three of the fifty winter varieties bore more or less blossoms, though few of these matured any fruits.

The Lord Suffield deserves mention as a promising late summer apple for family use. In spite of the general scarcity, this tree bore a good crop of large and fine fruit. The first samples were ripe about August 5, and others continued to mature until after the middle of September. In quality they were fair for dessert use, but would probably prove excellent for cooking.

The cherry trees have suffered a considerable mortality. Those of the plum and pear, however, have made a good growth. A portion of all of these may be expected to bear some the coming season.

In all the orchard fruits careful notes have been kept of the various details of growth, as the date at which the first leaves and blossoms appear, the time when the leaves commence to fall, and have all fallen, the length of new growth, etc. In the case of the apple, these notes are already developing some interesting facts. The time of maturity of the leaves appears to be a well marked variety character, and hence it may be used in describing varieties. It has been observed that in a large part of the Russian apples on trial, the leaves begin early to turn yellow, and nearly all fall immediately after the first frost, while in the greater part of the native sorts the leaves show no signs of maturity until frost, after which they turn brown, shrivel and fall apparently without ripening. The greener the foliage the more frost it appears to endure without being killed.

SEEDLING FRUITS.

SEEDLINGS FROM FEW AND MANY SEEDED FRUITS.

In the Station report for 1885, p. 229, is noted an experiment in growing seedling raspberry plants from few and many seeded fruits, from which it appears that the plants from the few seeded fruits yielded berries of better average quality, than those from the many seeded fruits.

The past season, the same result was noted in respect to the black-cap, or *Rubus occidentalis* type. Several plants of the red raspberry type, *R. strigosus*, came into bearing for the first time, and in those the difference was less marked. I think it doubtful whether the plants from the few seeded fruits produced berries of better quality than those from the many seeded ones.

In current seedlings grown from few, and many seeded berries, the plants from the latter were on the average more vigorous in growth, and came into bearing rather earlier than those from the former. In the size of the berries, or of the bunches, or in the acidity of the fruits, no special difference was discernible.

SEEDLINGS FROM WILD FRUITS.

A quantity of seedlings has been grown of the dwarf Juneberry, *Amelanchiar Canadensis*, var. *oblongifolia*, and also of the thimble berry, *Rubus odorata*. The first of these gives promise of value as an addition to our hardy fruits, as the plants are prolific, and the fruit is of fair quality. It is desired to observe the amount of variation in the seedlings of both these fruits, and to make the experiment of hybridizing the *Rubus odorata* with the common raspberry.

In growing seedlings from the huckleberry, no success has thus far been attained. The young plants have failed to develop under any method yet tried. The immense natural plantations of the various species of this fruit, which must largely be produced from seed, prove beyond question that when the secret of their culture is once learned, there should be no trouble in growing the seedlings. Other experiments are to be made as soon as seed can be procured.

Several hundreds of seedlings from named varieties of the raspberry and gooseberry will come into bearing next season, and a large planting of strawberry seedlings from excellent named varieties grown in close proximity was made the past summer.

GRAPES.

All of our grape vines endured the past severe winter without serious injury. A few canes on some young vines upon which the wood did not appear to be well ripened in the fall were purposely left unpruned, in order to see how far down the wood would be killed. In some cases canes that were of a green color at the time the leaves fell came through alive, but such were invariably killed back for a certain distance at the tip.

Ten of our vines bore some fruit the past season. Marvin's Centennial was set in 1883; all the others noted in the table in 1882. Amber Queen, Burnet, Lady Washington, Monroe, Moore's Early and Senasque bore their first crop in 1885; the others bore first the past season.

The data noted regarding the ten bearing varieties are as follows:

GRAPES.	First leaves appeared.	First flowers opened.	First fruits ripe.	Last fruits ripe.	First leaves falling.	Last leaves falling.	Remarks.
Amber Queen.......	May 1	June 9	Sept. 8	....	Oct. 17	Oct. 23	Very vig.: yield ab'd't.
Burnet	" 3	" 14	" 20	....	" 17	" 23	" "
Francis B. Hayes...	" 1	" 15	" 10	Sept. 20	" 17	Nov. 11	Vig.: bore few b'nch's.
Jefferson	" 5	" 14	Oct. 9	....	" 19	" 11	Rather vig.: y'ld ab'dt.
Lady Washington..	" 3	" 15	Sept. 27	....	" 17	" 11	Very vig.: "
Marvin's Centennial	" 3	" 14	" 20	Oct. 9	" 17	Oct. 23	Gro'th f'ble: "
Monroe.............	" 6	" 14	before Sept. 4	....	" 17	Nov. 14	Very vig.: "
Moore's Early......	" 1	" 11	before Sept. 4	Sept. 8	" 17	" 1	Mod. vig.: "
Senasque...........	" 6	" 16	" 23	....	" 17	Oct. 29	Very vig.: "
Vergennes..........	" 10	" 14	" 18	....	" 17	Nov. 1	Vig.: bore very little.

The date when the first berries of Monroe and Moore's Early were ripe was not noted. No whole bunches, however, were ripe on September 4. The date when the last berries were ripe had to be omitted in many cases owing to pilferings.

The vines were all trained on the horizontal arm system, the arms being spread on the lower bar of the trellis, and the canes trained upward to the top.

Francis B. Hayes and Amber Queen appeared to me best in quality. Lady Washington, Jefferson and Vergennes were all excellent. The Burnet and Monroe were poorest.

NOTES ON MILDEW.

Marvin's Centennial was most seriously injured by mildew, and Burnet second. Amber Queen was considerably mildewed, and Senasque and Vergennes slightly. The others were not affected. Of those not yet in bearing, Catawba, Eumelan and Isabella were considerably injured, and Prentiss and Niagara slightly.

BAGGING GRAPES.

About one-half of the bunches of Amber Queen, Burnet, Lady Washington, Marvin's Centennial, Monroe, Moore's Early and Senasque were bagged the first week in July. Although no rot appeared on any of the vines, the appearance of the bagged bunches was so much superior to that of those left unprotected that this advantage alone would almost seem to warrant the expense of bagging. A severe hail storm on August 11 injured the fruit on some vines considerably, and it was noticed that those bagged nearly escaped harm. This is an advantage from bagging that does not appear to have often been mentioned. As a suggestion to those who have but few grapes, and do not care to go to the trouble of procuring bags, it may be added that pieces of old newspaper were used as an experiment on some of the vines with satisfactory results. It is not necessary that the paper should be made into a sack, as it is thought best to have the bottom of the bunch left partly open.

The only objection to the bagging noted was that spiders made their webs among the berries of bagged bunches more frequently than of those not bagged.

CROSS-FERTILIZATIONS.

An attempt was made to secure hybrids between the Concord and two wild species, *Vitis æstivalis* and *V. riparia*, with apparent success. Many berries of Concord fertilized with these species were secured, and the seeds are already planted. The flowers from the wild species which in former seasons have opened too early for crossing with the Concord and other improved varieties, were retarded by breaking off the first shoots that started in the spring.

TOMATO.

AN EARLY VARIETY OF THE UPRIGHT TYPE.

In our report for 1885, p. 184, is mentioned an attempt to produce, by cross-fertilization, a tomato having the habit of the French Upright or Tree tomato, (*tomate de Laye* of the French), but yielding smooth fruit, and maturing with our earliest market varieties. This attempt has proved successful. The seeds were planted March 20, and the first fruit ripened on August 6, or in 139 days. But one large-fruited variety of the ordinary type ripened so early as this, viz., the San Salvador (Dam. '86) and this was very poor in quality and deeply ribbed. The fruit from the upright plant, however, was very smooth, of good size, and of remarkable quality, containing but 48 seeds. Several other fruits were borne on plants of this type equal to the first in everything except earliness. A quantity of seed has been saved from the smoothest fruits borne by the earliest and most productive plants, for propagation next season.

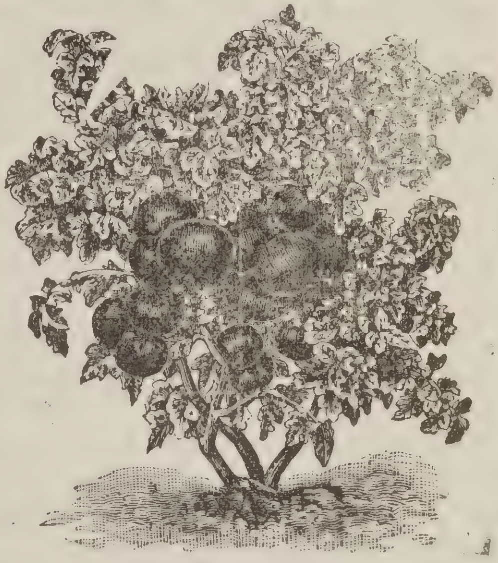
FIG. 1.

It is thought that in case this variety succeeds well under glass, it may prove of great value for forcing, as its extremely compact habit will render it well adapted for frame culture. A trial of it is to be made the coming winter in the greenhouse. A cut of one of the plants of this new tomato, taken from a photograph, is presented in Fig. 1.

THE INFLUENCE OF HEREDITY UPON VIGOR.

An experiment with the tomato carried on during the past three seasons, furnishes some striking and important results.

In the fall of 1883, a single plant was noticed in a row of the Little Gem tomato that appeared more feeble in growth and had more of its fruits decayed than any other. In order to find out whether or not this peculiarity would be inherited, a few of the sound fruits from this plant, with a few others from a neighboring one that appeared very vigorous and healthy, were selected for seed, and plants from the two selections were grown the following season.[1] The progeny of each plant resembled its parent except that that of the feeble one was still more feeble. The same selections were continued through 1885 and 1886, with similar results. The progeny of the feeble plant continued to become more feeble. The past season the enfeebled plants were scarcely more than one-fourth the size of the vigorous ones. The branches lay prostrate upon the ground, with discolored and shrivelled foliage, and fully one-half of the fruits decayed, leaving nothing but the dry skins. This decay is a soft rot, quite different from the black rot that often affects tomatoes. The fruit becomes soft, and collapses without changing color; the skin finally bursts, permitting the contents to flow out, when it dries, without detaching itself from the stem.

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[1] See Report New York Agricultural Experiment Station for 1884, p. 227.

Another line of experiments was commenced in 1883 on the use of seeds from immature fruits,[1] the variety being Cook's Favorite, a tomato rather closely resembling the Little Gem. It is a matter of interest that the results upon the health of the plant appear to have been the same as in the experiments noted above. The progeny of the green fruit has become so feeble that the plants are but quarter the size of those grown from ripe seed. They have the shrivelled and discolored foliage noted above, and a very large proportion of the fruits decayed as soon as, or even before they matured.

Prof. Arthur, who has examined the decayed fruits in both of these experiments, pronounces the rot due entirely to the enfeebled condition of the plant and not to any hereditary or contagious fungous disease.

These results show clearly that the selection of seed in the tomato is a subject of importance, and that the vigor and health of varieties is endangered by the use of immature seed; or seed from enfeebled plants.

INSECTS AND INSECTICIDES.

With the exception of aphides of many kinds, destructive insects were not especially numerous at the Station the past season. Potato beetles, cucumber beetles, flea-beetles and currant worms came in their usual numbers, and were treated by the methods that have been found most satisfactory in former seasons. For the benefit of those who may not have our previous reports at hand, these methods are briefly noted here, with such qualifications as the experience of the past seasons suggests.

For the larvæ of the potato beetle, *Doryphora decemlineata* (Say), Paris green thoroughly mixed with land plaster at the rate of one part to 150, was dusted over the plants with the ordinary sifting box. For the beetles themselves the mixture was made stronger, one part of the poison to 100 of the plaster being used.

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[1] See Report New York Agricultural Experiment Station, 1884, p. 224; 1885, p. 182.

For the cucumber beetle, *Diabrotica vittata* (Fabr.) nothing has proved so satisfactory for plants started in the open ground as covering the hills with plant protectors of some kind. The experience of the past season shows that growing melons and cucumbers in drills is not a sure preventive from destruction by the beetle, at least, not when the same soil is planted for several years in succession. Entire rows of plants in which the seeds were placed but two to three inches apart, on ground planted to melons and cucumbers since 1883, were totally destroyed.

A method that has proved satisfactory is to start the plants of melons and cucumbers on inverted sods in the cold frame, and after they have attained two or three rough leaves, remove them to their permanent place. If the transplanting is done carefully, so as not to remove the roots from the sod, and in rainy weather, the plants grow on so rapidly that they are little harassed by the beetles.

In the Station report for 1884, p. 316 it is recommended to grow cabbage and other plants that are injured by the turnip flea-beetle, *Phyllotreta striolata*[1] (Fabr.) within a frame of wide boards. The experience of the past two seasons shows that this proves reliable only when the frame is surrounded by a broad belt of sod of one or more years standing. Placed on the cultivated ground of the garden, the beetles may appear in sufficient numbers within the frame to injure, or even destroy the plants. From this fact, it seems probable that the beetles do not hybernate much in sod ground.

As noted in the Station report for 1885, p. 222, mulching the soil between currant bushes with coal ashes appears to be a partial preventive of injury from the currant worm, *Nematus ventricosus*, (Klug.) At least in a plantation of currants made in the spring of 1884 and mulched with coal ashes, the injury has been decidedly less than on an old plantation that has not been thus mulched. As a sure remedy for this pest, nothing better has been found than powered white hellebore, applied with water with the common sprinkling pot. A tablespoonful to three gallons of water, is sufficient.

The green cabbage worm, larva of *Pieris rapæ* L. was less destructive than usual the past season. The contagious disease noted in our last report, p. 220, again destroyed large numbers of the caterpillars. A single application of Pyrethrum powder diluted with three parts of air-slacked lime proved sufficient. The cabbage plantation was unusually large the past season, which doubtless accounts in a measure for the slight injury from this pest. It is well known that on large plantations the damage is almost always less than on garden patches.

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[1] In previous reports the name *Haltica striolata* is used for this insect. The above name is adopted on the authority of Prof. J. A. Lintner, N. Y. State entomologist.

For the squash vine borer, *Melittia cucurbitae* (Harris), the experiment made in 1884 and 1885[1] was repeated. This consisted in placing corn cobs dipped in coal tar among the plants about the first of July. The borer scarcely appeared at all, however, and plants that received no treatment suffered very little. In a plat containing fifty plants, on which no cobs were placed, seven borers were found, while in a plat of sixteen plants on which the cobs were used, none were found.

APHIDES.

As already noted, the damage from aphides the past season was unusually large. During the spring and the first half of summer, nearly all garden plants and fruit trees were more or less infested. Even the water lily, *Nymphaea odorata*, growing in tubs in the Station lawn, was found to be covered with plant lice in July, wherever the leaf stems were exposed above the water. In the extensive nurseries about Geneva the damage caused to plantations of apple, pear, plum and cherry trees by these insects was estimated at many thousands of dollars.

It is safe to say that no satisfactory method is known for avoiding the injury from these pests in seasons when the conditions are favorable for their rapid multiplication. Kerosene emulsions and whale oil soap washes, when made of proper strength, destroy all the lice that can be reached, without much injury to the foliage; but owing to the rapidity with which the insects multiply, and the practical impossibility of reaching all at one application, these means prove far from satisfactory.

Nothing new was developed in the experiments made at the Station. A mixture of lime water and kerosene was tried as a substitute for the soap emulsion. This was equally efficacious, with the advantage that it does not cover the foliage with soap. To make this mixture, slack one pound of fresh lime in five quarts of water and add one part in fifteen by measure of kerosene. When shaken well it is sufficiently permanent for the purposes of application. Tested for the root aphis, on lettuce, it appeared to do no good.

Hot water was also tried. The difficulties attending its application are so great, and the range of temperature at which it may be used with safety to the foliage, and destruction to the insects is so slight that it must be regarded as impracticable. Tests of solutions of corrosive sublimate and carbolic acid were found to injure foliage without being fatal to the insects.

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[1] See report New York Agricultural Experiment Station, 1884, p. 318; 1885, p. 216.

It is possible that had a thorough application of the kerosene emulsion, or a solution of whale oil soap been made at the first appearance of the leaves, the damage might have been largely prevented. The advantage of treating the insects at this time is two fold. The leaves are small and upright, so that the liquid can be applied to both surfaces more readily, and the aphides are then few and the number that survive will be but a mere fraction of those that escape after the trees are in full leaf.

Various lady-bug beetles (Coccinellidae) are known to destroy great numbers of aphides. During the latter part of the season these insects appeared in unusually large numbers, the vast swarms of aphides probably furnishing favorable conditions for their multiplication. This suggests the question: May not some artificial food be found for these beetles, that can be applied to fruit trees in the form of a wash, and thus favor their multiplication in all seasons?

PARIS GREEN FOR THE CIRCULIO.

It has frequently been stated that Paris green and water applied to the foliage of plum trees will prevent injury by the circulio. As an experiment, one-half of a seedling plum tree was sprayed with this mixture at the rate of one ounce to ten gallons. This was the only bearing plum tree at hand except those in the poultry yard, which are rarely attacked by the curculio. The first application was made May 10, a second May 17, and a third later, date not noted. Unfortunately the doses proved too severe for the foliage, though the effect was not immediately noticeable. About midsummer the leaves on the sprayed side of the tree began to drop and continued to do so until more than half of them had fallen. The fruit did not mature naturally, and mostly dropped early, hence it could not be determined how far, if at all, the injury was due to the curculio.

HYPOSULPHITE OF SODA AS A PREVENTIVE OF SCAB ON THE APPLE AND PEAR.

In our report for 1885, p. 231, the result of an experiment is noted in the use of a solution of hyposulphite of soda for the apple scab, *Fusicladium dendriticum* (Fckl.) from which it appears that the fungus was somewhat lessened by the applications. The experiment was made upon one side of a tree of the common Siberian crab, leaving the other side untreated.

The past season the applications were repeated upon this tree in the same manner as in 1885, and a tree of Seckel pear, on which the fruit has been much injured in past seasons by another species of *Fusicladium*, was also treated on one side.

The solution was applied to both the crab and pear tree four times, viz., on April 22, May 6, May 10 and May 17. The first three applications were at the rate of one pound of the hyposulphite to ten gallons of water, and the last was of half that strength. It was found that the second and third applications injured the foliage of the pear tree slightly, and hence the last one was diluted one-half.

The results in the case of the crab tree were very striking. The part of the tree sprayed with the solution bore a fair crop of medium sized fruit, while the other brought no fruit to maturity. Both sides of the tree bloomed profusely, and early in the season both had a fair setting of fruit. I am not sure whether or not as much fruit set on the side not sprayed as on the sprayed side, but when the fruit on the latter had ripened, only specimens ruined by the fungus were to be seen on the side of the tree not sprayed.

In the case of the pear tree, the result was less striking. The fruits were picked August 28, and the yield from each side assorted into two qualities. Only those not sufficiently injured by the fungus to affect their market value were placed in the first quality.

Of 486 fruits picked from the sprayed part of the tree, 290, or 59.65 per cent. were found to be in the first quality.

Of 213 fruits picked from the side of the tree not sprayed 115, or very slightly less than 54 per cent. were placed in the first quality.

It appears that the slight difference is in favor of the sprayed side. It should be added that the second quality from this side was perceptibly better than from the side not sprayed.

AN APPLICATION FOR PEAR BLIGHT.

At the suggestion of Prof. Arthur, the same solution was applied to the foliage of one Boussock and three Bartlett pear trees to see whether it might not act as a preventive of the pear blight. The trees were sprayed on the same dates as noted above, the first application being made before the leaves were fully developed. One of the Bartlett trees was attacked with blight during the summer, and thus the question is answered in the negative.

THE INFLUENCE OF FOREIGN POLLEN UPON THE CHARACTER OF FRUIT.

1st. *The Strawberry.*

In our report for 1885, p. 227 is reported an experiment in fertilizing the blossoms of the strawberry with pollen from other varieties, in order to discover the effect, if any, on the fruit. The result appeared negative. A similar experiment was made the past season.

A number of plants of the Crescent strawberry were potted in the fall of 1885 and wintered over in a cold frame. In the spring the pots were plunged in the garden until the flower buds appeared, when they were removed to the greenhouse and inclosed in a frame covered with mosquito netting. The plants were kept enclosed in the frame at all times except while the work of fertilization was going on. They were divided into four lots, and as the flowers opened, those of one lot were fertilized with pollen from the Sharpless, those of a second with that from Wilson, of a third from Lennig's White, while those of the fourth lot were not fertilized at all. In one plant, two flowers were fertilized on one side of the receptacle with pollen from the Sharpless, and on the other with that from Lennig's White. After the plants had finished flowering they were removed to the garden and bedded out. Unfortunately the removal was followed by very warm and dry weather and in spite of waterings, the foliage shriveled considerably and the berries were in consequence diminutive in size. The value of the experiment was not however destroyed. It was very clear that the berries from blossoms fertilized with pollen from Lennig's White were not different in color from those fertilized with that from Wilson or Sharpless. The flowers fertilized on one side with pollen from Sharpless and on the other with that from Lennig's White matured symmetrical fruits, which were uniform in color on both sides. Some berries were irregular in form among those fertilized with pollen from each of the three varieties, but it could not be said that more irregularity appeared in one lot than in another.

One thing however was plain. The proportion of berries secured depended upon the abundance of the pollen furnished by the variety used as the fertilizer. The Wilson yielded less pollen than either of the other varieties, and it was found more difficult to secure berries with pollen from this sort, a point which may have a practical bearing. Whether or not the same law holds under natural conditions, it is impossible to say, but it seems probable that it might. It is quite possible therefore that the *quantity* of fruit depends to some extent upon the abundance of the pollen yielded by the variety used as the fertilizer.

The flowers of Crescent, not consciously fertilized at all, produced and matured some fruit that bore apparently normal seeds. While open, these flowers were several times examined, and not a single anther was found. The plants bearing them were kept within the same frame as the others. Whether the pollen was disseminated into the air from the brushes used in fertilizing the other plants, and so fell upon these flowers in sufficient quantity to effect fertilization, or whether the flowers really did contain a few fertile anthers that escaped observation, I do not know. It is clear that in an experiment of this kind, the plants to be differently treated should not be inclosed within the same frame, and if possible, not within the same room.

2nd. *The Grape.*

If foreign pollen exerts an influence upon the character of the fruit in the grape, it would be expected that the blossoms of black varieties fertilized with pollen from white ones, would produce berries of lighter color than would self-fertilized blooms.

The flowers of several bunches of the Burnet, Monroe and Senasque, all black grapes, were castrated before the caps had fallen, and inclosed in paper bags. In due time they were fertilized with pollen from the Lady Washington, a white grape, and again inclosed in bags, in company with several other bunches on the same vines that had not yet opened their flowers. Thus some of the bunches on each vine must have been self-fertilized and others cross-fertilized with the Lady Washington. When the grapes had matured, it was quite impossible to detect any difference either in color or flavor between the self-fertilized and the cross-fertilized berries of the same variety.

From these experiments and the one made in 1885, it would appear that the cases, if any, in which the pollen of one variety of strawberry or grape has an influence upon the fruit of another, must be regarded as exceptional.

AN ATTEMPT TO SECURE A RECORD OF THE SOIL MOISTURE.

We know of no reliable method for securing an accurate record of the degree of moisture contained by the soil. The operations of the laws that govern the movements of water in the soil, though of vast importance to agriculture, are not well understood. Hence an investigation has been undertaken during the past two seasons to discover a way whereby the moisture of the soil can be measured and recorded. As an aid to the discussion, experiments that gave only negative results are briefly alluded to, with the reasons for their failure.

The first attempt, consciously a rude one, consisted in burying common bricks about eight inches deep in the soil in autumn, to be taken up from time to time during the following season, and the per cent. of water in them determined by drying. This method besides being very inconvenient, proved entirely unreliable. The bricks were found to be incapable of taking up more than half the percentage of water that the soil in which they were buried would contain.

Samples of a very porous kind of brick were obtained through the courtesy of the International Terra Cotta Lumber Co., of Chicago. This material obviated the objection noted above, as it was found to contain quite as much water to a given bulk, as would the soil. Another objection appeared, however. The terra cotta had a stronger affinity for water than the soil, in consequence of which it would become saturated during rains and would not part with its water as rapidly as would the soil.

Pieces of pine wood were also tested to see if the degree of expansion by absorption of moisture would represent the water content of the soil, but these appeared to offer the same objection as that noted for the terra cotta.

A method that it was thought must prove reliable was to take actual samples of the soil and determine the moisture by drying. This proved unsatisfactory for various reasons. The soil as a rule is neither homogeneous nor level. It is thus unequally wet by rains. The water flows from the ridges and settles in the hollows. The amount of organic matter the sample happened to contain would also exercise a a marked influence upon its water content. Again, the act of taking the sample would necessarily loosen the soil more or less at that place and hence cause it to dry out more rapidly than elsewhere in dry weather and to retain more moisture during rains. This made it impracticable to take samples from the same locality from day to day, and hence the results secured were not comparable.

At last a clue was found that appears up to the present time to obviate the objections noted. It is well known that the rapidity of evaporation from a moist surface exposed to air is in proportion to the dryness of the surrounding atmosphere, modified by temperature. Does a similar rule apply to the soil, *i. e.*, is the rapidity with which the soil absorbs water from a moist surface in contact with it, in proportion to its degree of dryness? A variety of experiments was made, intended to throw light upon this question, and while the apparatus used was improvised, and hence necessarily more or less imperfect, the indications are decidedly in the affirmative.

In these experiments the apparatus used is illustrated in Fig. 2 and may be described as follows :

Into the short arm of a tube resembling the one used to contain the water in the wet bulb hygrometer, a cylindrical piece of terra cotta, *a*, was loosely fitted, to act as a substitute for the wick. Its lower end reached into the bend of the tube, and its top projected slightly above the end of the short arm. The long arm of the tube, *b*, instead of being closed at the top, as in the wet bulb hygrometer, was provided with two stopcocks, *d*, *d*, placed one above the other, and the part of the tube between the cocks, *c*, was graduated to cubic centimetres. The object of the cocks is to permit the filling of the tube with water, without removing it from the earth.

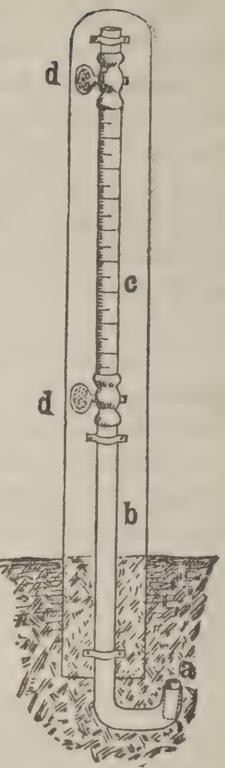

FIG. 2.

Such an apparatus was placed in the soil of a bare spot in the garden early in September, the lower end being set about six inches below the surface, while the long arm extended upright into the air. The piece of terra cotta, being in contact with the soil at its upper and with the water of the tube at its lower end, transmitted the water as fast as the soil absorbed it, and as the short arm of the tube became empty, a bubble of air would rise in the long arm, and thus admit more water. By means of the graduated section at the top of the tube, the absorption could be measured.

A careful record of the absorption was kept from September 5 to October 16. In the following table, is shown a comparison between the record of the wet bulb hygrometer, the absorption from the apparatus just described, and the rain fall, for six consecutive weeks. The wet bulb hygrometer was read three times each day, at 7 a. m., 12 m., and 6. p. m. The differences between the readings of the wet and dry bulb are all added together to furnish the figures of the first column ; the second column shows the total absorption by the soil during the same period, and the third the total rainfall.

	For the week ending	Total differences of wet and dry bulb.	Total absorption.	Total rainfall.
	Sept. 11	100.1 degrees	$20\frac{15}{20}$ cubic cent.	.10 inches.
	" 18	66.0 "	$12\frac{16}{20}$ " "	.51 "
(8 days)	" 26	46.7 "	$4\frac{17}{20}$ " "	1.30 "
	Oct. 3	42.0 "	$7\frac{9}{20}$ " "	.40 "
	" 10	46.1 "	$5\frac{14}{20}$ " "	. 0 "
(6 days)	" 16	33.3 "	$3\frac{1}{20}$ " "	. 0* "

*.13 inch of rain fell during the last day of the trial, but this is not noted, as it affected but a single reading.

It is clear from this table that the absorption diminished nearly in proportion to the diminution of the differences of the wet and dry bulb, and that during the week of excessive rain, it was correspondingly less. We should expect that in general terms, the moisture of the soil would have some relation to that of the air during weekly periods, and the table shows that a relation did exist between the moisture of the air and the absorption by the soil, though it was modified by the rainfall, which is also as we should expect.

Several other experiments conducted in the office with similar apparatus, using bottles of soil, gave additional evidence of the feasibility of this method for recording the soil moisture. The effects of temperature and other modifying influences upon the absorption, as well as a method for calculating the actual moisture from the readings of the apparatus remain to be worked out.

THE COMPARATIVE MOISTURE OF CULTIVATED GROUND AND SOD IN SUMMER WEATHER.

Out of many tests of the soil moisture made by drying actual samples of soil, a single series is reported, indicating the difference in the percentage of water contained in cultivated ground and sod, in moderately dry summer weather. The cultivated soil had produced a crop of peas early in the season, but the vines had been removed several days before the tests were commenced. The sod was in an orchard of young apple trees, but the samples were taken from a part not in the least shaded by the trees, and as far from them as possible. A crop of grass had been removed from it in June, and the second growth was three or four inches high at the commencement of the test. The cultivated soil was the more fertile of the two. The tests were commenced Aug. 23, the last rain (.58 inch) having fallen Aug. 16. The samples were taken by means of an instrument resembling a butter tester, the blade being inserted to the depth of six inches. After drying, the samples were washed through a sieve of one-tenth inch mesh, the stones and other substances that would not pass through the seive being then dried, and their weight deducted both from that of the fresh and dried sample.

The data obtained are as follows :

Sample taken.	Per cent. of water. Sod.	Per cent. of water. Cultivated ground.	Rainfall.
Aug. 23	16.89	20.46	.31inch.
" 24	19.72	22.30	
" 26	17.16	20.75	
" 27	18.80	20.81	
" 28	14.36	18.53	
" 30	15.72	18.82	.80 inch.
" 31	20.68	22.86	
Average	17.62	20.66	

It may be noted that the per cent. of moisture sometimes appeared to increase without rain, a result which may be due to the inaccuracy of the method.

CABBAGE.

A TEST OF VARIETIES.

So far as the number of varieties is concerned, the test of cabbages made the past season was an elaborate one. The entire catalogue list was ordered from the principal American seedsmen, as well as a large number of packages from France, Germany and Italy. All together, the list included 196 differently worded names. As appears from tbe table, some of these names were grown from several different seedsmen.

Three separate plantings were made. The first, reported in the first table, included 58 early cabbages, and was made in boxes in the hot-bed Mar. 4, the plants being transplanted to the garden May 3 and 4. A second planting, including both early and late sorts, was made in boxes in the cold frame May 6–10, and the plants were transplanted June 5-9. The third planting, in the main a duplicate of the second as regards varieties, was made in the open ground May 7–10, the seeds being sown thinly in drills, and the young plants thinned when of the proper size, to one and a half to two feet apart in the row. In all the plantings, packages bearing the same name from different seedsmen, were treated as different varieties.

The soil was well fertilized with stable manure, and ploughed in the fall of 1885. In the spring, before planting, it was thoroughly cultivated, but not plowed. The rows were in all cases three and a half feet apart, and the transplanted plants were set two feet apart in the rows. Twelve plants to each name were intended in each of the three plantings, but some did not survive, though the plantings were reset once. The cultivation all had to be done by hand, as the garden beds are too narrow to admit of horse culture.

Through the courtesy of Prof. W. R. Lazenby, and Mr. W. J. Green, of the Ohio Experiment Station, an exchange was made, whereby our number of samples of seed was considerably increased. The cabbages grown at the Ohio Station and at our Station the past season were thus largely from the same seed packages, and hence a comparison of results may be expected to furnish some interesting data in relation to the influence of different soils upon the varieties of the cabbage.

The amount of data is so large that the tables are necessarily somewhat complicated. The second table includes both the second and third plantings, and in addition to the data noted in the first table, the day on which the largest number of heads was cut is recorded, as an additional index of the comparative earliness of the varieties.

CABBAGE—FIRST PLANTING—EARLY VARIETIES ONLY.

PLANTS TRASPLANTED FROM HOT-BED.

	Seed from *	First head formed.	Days from planting.	No. of plants survived.	No. of heads formed.	Av. diameter heads-inches.	Av. weight heads—ounces.
All Seasons	Greg.	July 23	140	8	5	7	45
Cannon Ball	“	“ 16	133	12	12	5⅓	31
Earliest Dwf. Conical German	H. & S.	“ 16	133	12	12	6¾	49
Early Bacalan	Vil. '85.	“ 20	137	7	6	5	31
Early Bleichfeld Giant	Land.	“ 25	142	11	8	6¾	41
Early Deep Head	Greg.	“ 27	144	5	4	9	91
Early Drumhead	Sib.	“ 25	142	10	10	5½	29
Early Dutch Drumhead	Vil. '85.	“ 16	133	9	9	5⅓	36
Early Dwarf Dutch	Sib.	“ 27	144	6	5	7	62
Early Dwarf York	“	“ 1	119	10	8	5¼	37
Early Etampes	Dept. Ag'l.	“ 14	131	11	9	6¼	35
“ “	Sib.	“ 17	134	7	5	5	31
Early Flat Dutch	Hen.	“ 12	129	6	6	7	58
“ “ “	Thor.	“ 15	132	10	8	7¼	52
Early French Oxheart	Hen.	“ 14	131	10	10	7	47
“ “ “	Sib.	“ 14	131	11	8	4¾	31
Early Jersey Wakefield	Greg.	“ 14	131	12	12	5	28
“ “ “	Sib.	June 30	118	10	9	5¾	40
“ “ “	Thor.	“ 30	118	10	9	6	49
Early Oxheart	Greg.	Aug. 10	159	8	6	5⅓	36
“ “	Vil. '85.	July 17	135	12	11	6	37
Early Paris	Greg.	“ 10	128	8	8	6½	53
Early Paris Market	Vil. '85.	“ 24	142	10	10	7	57
Early St. John's Day Drumhead	Hen.	“ 24	142	4	4	7	62
Early Schweinfurt	Sib.	“ 24	142	10	7	9	80
Early Summer	Till.	“ 16	134	12	11	8	73
Early Winnigstadt	Dept. Agl.	“ 15	133	11	8	6	45
“ “	Greg.	“ 15	133	10	10	6	48
“ “	Hen.	“ 15	133	12	12	5	34
“ “	Sib.	“ 24	142	12	7	7	57
“ “	Thor.	“ 16	134	11	9	5	43
Early Wyman	Greg.	“ 16	134	9	9	7	44
“ “	Sib.	“ 16	134	12	10	6	39
Early York	Greg.	“ 13	131	12	9	5	33
“ “	Hen.	“ 24	142	9	5	4	24
“ “	Sib.	“ 5	123	10	10	4½	23
“ “	Thor.	“ 10	128	9	9	4½	22
“ “	Vil. '85.	“ 7	125	11	10	4½	26
Etampes	Thor.	“ 6	124	11	8	7	47
Everitt's Mammoth Late Flat Dutch	Ev't.	“ 3	121	9	7	5	30
Henderson's Early Summer	Greg.	“ 16	134	11	8	7	52
“ “ “	Hen.	“ 24	142	7	7	7	52
“ “ “	Sib.	“ 23	141	11	11	7½	65
Henderson's Sel. Early Jer. Wakefield	Hen.	“ 10	128	12	11	4	18
Improved Early Summer	Thor.	“ 13	131	12	10	7	48

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*For explanation of the abbreviations, see close of the report of the Horticulturist.

CABBAGE—FIRST PLANTING—EARLY VARIETIES ONLY (*Cont'd*).

PLANTS TRANSPLANTED FROM HOT-FED.

	Seed from.	First head formed.	Days from planting.	No. plants survived.	No. heads formed.	Av. diameter head—inches.	Av. weight head—ounces.
Jersey Wakefield	Till.	July 10	128	11	11	4½	24
Johnson & Stoke's Earliest	J. & S.	“ 3	121	12	12	5	28
Large Early Schweinfurt	Hen.	Aug. 28	177	10	8	10	71
Large Early York	“	July 13	131	10	5	6	35
“ “ “	Thor.	July 13	131	12	11	5	39
Little Pixie	Greg.	“ 15	133	8	7	5	24
“	Sib.	Aug. 9	158	8	6	7	44
Louisville Early Drumhead	Dep't Ag'l.	July 15	133	9	9	7	48
Low's Early Peerless	“	“ 9	127	12	7	7½	58
“ “ “	Greg.	“ 16	134	9	3	9	75
Newark Early Flat Dutch	“	“ 12	130	11	7	6	41
Nonpareil	Vil. '85.	“ 15	133	8	5	4½	25
“ Early	Greg.	“ 16	134	10	5	6	41
Pomeranian	Vil. '85.	Aug. 3	152	12	10	5¾	47
St. John's Day Early	Sib.	“ 22	140	6	4	6	36
“ Early	Vil. '85.	“ 20	138	6	2	5	22
Schweinfurt	“	“ 28	146	9	11	10	88
“ Quintal	Greg.	“ 27	145	10	10	11	115
Sugar Loaf	“	“ 15	133	10	10	5	37
“	Vil. '85.	“ 22	140	10	7	5½	45
Tourlaville	Greg.	“ 21	139	12	9	6½	64
“	Vil. '85.	“ 20	138	5	5	6	40
Very Early Etampes	Greg.	“ 31	149	8	7	5	34
“ “ “	Vil. '85.	“ 12	130	7	6	5½	35
Vilmorin's Early Flat Dutch	Greg.	July 20	138	12	12	6	41
Wheeler's Cocoanut	“	“ 23	141	8	7	6½	48
Winnigstadt	Land.	“ 13	131	11	11	6	47
“	Vil. '85.	“ 20	138	11	11	5	35
RED CABBAGES.							
Earliest Blood Red Erfurt	Sib.	July 28	146	10	5	4½	24
Early Blood Red Erfurt	Greg.	“ 10	128	12	10	4½	19
“ “	Hen.	“ 6	124	12	12	4½	21
Early Dark Red Dutch	Vil. '85.	“ 28	146	10	10	5	34
“ “ Erfurt	Greg.	“ 6	124	12	11	5	21
“ “ “	Vil. '85.	“ 13	131	10	8	3	13
SAVOY.							
Early Dwarf	Thor.	July 20	138	10	3	5½	26
Early Ulm	Greg.	“ 25	143	5	4	5	23
“	Thor.	“ 24	142	9	6	4½	26
Small Early Ulm	Vil. '85.	“ 16	134	8	6	5	27
Very Early Paris	Greg.	“ 6	124	7	7	4½	22
“ “	Vil. '85.	“ 13	131	11	8	5	23

CABBAGE—SECOND AND THIRD PLANTINGS—EARLY AND LATE VARIETIES.

NAME.	Seed from.	SEEDS PLANTED IN OPEN GROUND.								PLANTS TRANSPLANTED FROM COLD FRAME.							
		First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants.	Number of heads fmd.	Avg. diamet'r of heads.	Average wt. of heads.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Nnmber of plants	Number of heads fmd.	Ave. diamet'r of heads.	Average wt. of heads.
								in.	ozs.							in.	ozs.
All Head, or Sure Head	Ev't.	Aug. 18	103	Oct. 12	158	8	3	7	69	Aug. 18	104	Oct. 25	172	12	11	9	109
All Seasons	Greg.	“ 18	103	“ 12	158	12	12	9	107	“ 18	104	Sept. 28	145	12	8	9	124
Amager Danish Winter Round	Ben.	....	......	....	......	....	....	....	......	Sept. 7	124	Oct. 25	172	12	12	7¾	99
Berkshire Beauty	Greg.	Sept. 1	117	Sept. 27	143	12	11	9	127	Aug. 21	107	Sept. 28	145	12	11	9	94
Bloomsdale Brunswick	Land.	“ 1	117	Oct. 25	171	12	11	10	135	“ 24	110	“ 1	118	12	12	9	102
Bloomsdale Bullock's Heart	“	“ 6	122	“ 12	158	12	12	8	90	Sept. 4	121	Oct. 25	172	12	12	7	90
Bloomsdale Early Drumhead	“	“ 4	120	“ 12	158	11	11	8¼	110	“ 8	125	Sept. 28	145	12	11	8½	82
Bloomsdale Early Dwarf Flat Dutch	“	Aug. 29	114	“ 12	158	12	10	7¾	85	Aug. 21	107	“ 28	145	12	10	8½	119
Bloomsdale Early Market	“	“ 30	115	“ 12	158	12	12	8½	117	“ 21	107	“ 23	140	12	12	8	107
Bloomsdale Large Flat Dutch	“	Sept. 21	137	“ 12	158	12	12	8½	104	Sept. 4	121	Oct. 25	172	12	12	7	80
Bridgeport Late Drumhead	Greg.	“ 18	134	“ 25	171	12	11	8½	130	“ 21	138	“ 25	172	12	12	8¾	134
Brill's Excelsior Flat Dutch	Brill.	“ 7	123	“ 25	171	11	11	9	133	“ 4	121	“ 25	172	12	10	10	124
Bristol Flat Dutch	“	“ 21	137	“ 25	171	12	12	8¾	107	“ 7	124	“ 25	172	12	12	9	120
Bronski Russian	Ben.	Aug. 25	110	Sept. 27	143	12	11	5	33	Aug. 6	92	Sept. 1	118	12	10	4½	29
Brunswick Short Stem	Vil. '85	Sept. 4	120	“ 27	143	11	11	8½	69	Sept. 4	124	“ 28	145	12	11	9½	121
Buists Late Drumhead Improved	Buist.	“ 25	141	Oct. 25	171	12	11	7½	103	“ 30	147	Oct. 25	172	12	11	9	114
Buists Late Flat Dutch	“	“ 28	144	“ 25	171	12	11	9	100	“ 1	117	“ 12	159	11	9	7	61
Burpee's Early Advance	Burpee	“ 4	120	Sept. 27	143	5	3	7	57	“ 6	123	“ 25	172	12	11	7½	82
Burpee's No. 2	“	Aug. 25	110	Oct. 25	171	3	1	5¾	41	Aug. 23	109	Sept. 10	127	12	11	6½	55
Burpee's Short Stem Drumhead	“	Sept. 4	120	Sept. 27	143	6	6	9	116	Sept. 10	127	Oct. 25	172	12	10	8	89
Burpee's Superior Large Flat Dutch	“	....	......	....	......	....	....	....	......	“ 10	127	“ 25	172	12	12	7½	76
Burpee's Sure Head	“	“ 4	120	Oct. 25	171	11	11	9	101	“ 6	123	Sept. 28	145	12	11	7	67
“ “ “	Brill.	“ 4	120	“ 25	171	12	10	10½	121	“ 7	127	Oct. 25	172	12	12	7½	76
Cannon Ball	“	“ 1	117	Sept. 27	143	12	12	7	70	Aug. 9	95	Sept. 15	132	12	12	7⅓	78
“ “	Greg.	Aug. 31	116	“ 27	143	12	12	6½	58	....	......	....	......	....	....	....	......
Danish Drumhead	“	“ 29	114	Oct. 12	158	12	12	9⅓	126	Aug. 31	117	Sept. 22	139	12	6	9	102
Dax	Vil. '85	Sept. 10	126	“ 25	171	11	5	10	91	“ 18	104	Oct. 25	172	12	1	7¼	49
Drumhead Quintal	“	“ 1	117	“ 12	158	12	12	8	80	Sept. 1	118	“ 12	159	12	11	8½	73
Earliest Vesuvius	Dam.	Aug. 25	110	Sept. 27	143	12	7	7	51	Aug. 21	107	Sept. 28	145	12	12	4⅓	42
Early Bonanza	Buist.	Sept. 8	124	Oct. 25	171	12	6	8½	69	“ 9	95	“ 28	145	12	12	7	70
Early Bleichfeld Giant	Land.	Aug. 20	105	Sept. 27	143	12	11	7	86	“ 23	109	“ 15	132	12	9	8	90
Early Brunswick (Imported)	“	Sept. 1	117	Oct. 12	158	12	8	8	87	“ 31	117	“ 28	145	12	12	9	108
Early Cone	“	Aug. 29	114	“ 22	168	12	12	6	59	“ 25	111	“ 15	132	12	12	8	94
Early Deep Head	Greg	“ 30	115	“ 12	158	12	9	9	115	Sept. 1	118	Oct. 11	158	12	12	10	169

CABBAGE—SECOND AND THIRD PLANTINGS—EARLY AND LATE VARIETIES (*Continued*).

	SEEDS PLANTED IN OPEN GROUND.									PLANTS TRANSPLANTED FROM COLD FRAME.							
NAME.	Seeds from.	First head formed.	Days from planting.	Date of largest cutting.	Days from planting.	Number of plants.	Number of heabs fmd.	Av'g diam't'r of heads.	Average wt. of heads.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants.	Number of heads fm'd.	Av. diameter of heads.	Average wt. of head.
								in.	ozs.							in.	ozs.
Early Drumhead	Brill.	Aug. 21	106	Sept. 22	138	11	11	9½	106	...	...	...	...	...	...	...	...
" "	Land.	Sept. 1	117	Oct. 25	171	12	10	9	112	...	...	...	...	...	...	...	...
" "	Sib.	Aug. 16	101	Aug. 31	116	11	11	5¾	44	...	...	...	...	...	...	...	...
Early Dutch Drumhead	Vil. '85.	" 20	105	Sept. 4	120	12	12	7½	73	...	...	...	...	...	...	...	...
Early Dwarf Dutch	Sib.	Sept. 4	120	" 27	143	12	12	7½	76	...	...	...	...	...	...	...	...
Early Dwarf York	"	Aug. 26	111	" 4	120	10	10	6	56	...	...	...	...	...	...	...	...
Early Etampes	Brill	" 11	96	Aug. 31	116	12	12	5	43	Aug. 12	98	Sept. 1	118	12	10	5½	57
" "	D. of A.	" 14	99	Sept. 9	125	12	10	6½	51	" 21	107	" 8	125	10	8	6	50
" "	Ev't.	" 16	101	Aug. 31	116	12	12	6	51	" 5	91	" 1	118	11	11	6½	57
" "	Sib.	" 21	106	" 31	116	12	12	5	28	...	...	...	...	...	...	...	...
Early Flat Dutch	Hen.	" 11	96	Sept. 4	120	12	11	7¼	80	...	...	...	...	...	...	...	...
" " "	Land.	" 11	96	" 27	143	12	11	9	104	Sept. 4	121	Oct. 11	158	12	10	9	126
" " "	Thor.	" 20	105	Oct. 12	158	12	11	9½	130	...	...	...	...	...	...	...	...
Early French Oxheart	Hen.	" 21	106	Aug. 31	116	12	12	5½	48	...	...	...	...	...	...	...	...
" " "	Sib.	" 20	105	Sept. 4	120	11	11	5¾	51	...	...	...	...	...	...	...	...
Early Jersey Wakefield	Burpee	" 21	106	" 27	143	12	10	9	133	Aug. 10	96	Sept. 8	125	12	9	7¾	98
" " "	Ev't.	" 17	102	Aug. 31	116	12	12	6	46	" 9	95	" 1	118	12	12	6½	77
" " "	Greg.	" 19	104	Sept. 4	120	12	12	8	91	...	...	...	...	...	...	...	...
" " "	Hen. '84	" 5	90	Aug. 31	116	12	12	6¼	56	Aug. 6	92	Sept. 8	125	11	11	6	52
" " "	" '86	" 10	95	" 31	116	10	9	6½	59	" 10	96	Aug. 27	114	12	12	7	70
" " "	Sib.	" 10	95	" 31	116	12	12	6	50	...	...	...	...	...	...	...	...
" " "	Thor.	" 10	95	" 31	116	12	10	5½	46	...	...	...	...	...	...	...	...
" " "	Till.	" 10	95	" 31	116	12	12	6½	59	Aug. 6	92	Sept. 1	118	12	12	5½	44
Early Mongeibello	Dam.	" 23	108	Oct. 12	158	12	10	7½	64	" 21	107	" 1	118	12	12	7½	61
Early Oxheart	Greg.	" 12	97	Aug. 31	116	12	11	5½	33	...	...	...	...	...	...	...	...
" "	Vil. '85.	" 19	104	" 31	116	12	12	5¾	34	...	...	...	...	...	...	...	...
Early Paris	Greg.	" 10	95	Sept. 4	120	11	9	6½	54	...	...	...	...	...	...	...	...
Early Paris Market	Vil. '85.	" 4	89	Aug. 13	98	11	11	6¾	59	...	...	...	...	...	...	...	...
Early St. John's Day Drumhead	Hen.	" 9	94	Sept. 27	143	12	10	5½	37	...	...	...	...	...	...	...	...
Early Schweinfurt	Sib.	Sept. 8	124	Oct. 25	171	12	12	9¾	128	...	...	...	...	...	...	...	...
Early Sugar Loaf	Land.	Aug. 16	101	Sept. 13	129	12	12	5	45	Aug. 23	109	Sept. 8	125	12	12	5½	55
Early Summer	Brill.	" 21	106	" 13	129	12	11	7	82	" 17	103	" 27	144	12	12	8½	84
" "	Hen.	" 21	106	" 13	129	12	12	7	64	" 17	103	" 8	125	12	12	7¾	76
Early Winnigstadt	D. of A.	" 10	95	" 13	129	12	10	6	57	...	...	...	...	...	...	...	...

CABBAGE—SECOND AND THIRD PLANTINGS—EARLY AND LATE VARIETIES (*Continued*).

NAME.	SEEDS PLANTED IN OPEN GROUND.									PLANTS TRANSPLANTED FROM COLD FRAME.							
	Seeds from.	First head formed.	Days from planting.	Date of largest cutting.	Days from planting.	Number of plants.	Number of heads fmd.	Av. diameter of heads.	Av. weight of heads.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants	Number of heads fm'd.	Av. diameter of heads.	Av. weight of heads.
								in.	ozs.							in.	ozs.
Early Winnigstadt	Greg.	Aug. 18	103	Sept. 13	129	11	11	6	58	......	......	......	......	......	......	......	......
" "	Hen.	" 9	94	" 4	120	12	12	6	59	......	......	......	......	......	......	......	......
" "	Sib.	" 10	95	Oct. 12	158	12	9	7	71	......	......	......	......	......	......	......	......
" "	Thor.	" 10	95	Sept. 13	129	12	12	6	56	......	......	......	......	......	......	......	......
" "	Till.	" 10	95	" 4	120	12	9	6¾	69	Aug. 11	97	Sept. 8	125	12	12	6¾	86
" "	? Mic'84	" 10	95	" 4	120	12	12	6½	71	" 11	97	" 8	125	12	12	6¼	64
Early Wyman	Greg.	" 21	106	" 13	129	12	12	7	83	......	......	......	......	......	......	......	......
" "	Sib.	" 23	108	" 13	129	12	12	6½	59	......	......	......	......	......	......	......	......
Early York	Greg.	" 21	106	" 13	129	12	12	5½	54	......	......	......	......	......	......	......	......
" "	Hen.	" 11	96	" 13	129	12	12	5½	44	......	......	......	......	......	......	......	......
" "	Sib.	" 16	101	" 13	129	11	9	6½	54	......	......	......	......	......	......	......	......
" "	Thor.	" 9	94	" 13	129	12	12	5½	42	......	......	......	......	......	......	......	......
" "	Vil. '85	" 18	103	" 4	120	12	9	5	39	......	......	......	......	......	......	......	......
Early York—English	Land.	" 16	101	" 13	129	12	6	6	51	Aug. 10	96	Sept. 8	125	12	10	6	48
Erfurt Large Late	H. & S.	" 19	104	" 13	129	12	11	7½	106	" 21	107	" 15	132	12	12	7¾	79
Etampes	Thor.	" 10	95	Aug. 31	116	12	12	6½	64	......	......	......	......	......	......	......	......
Everitt's Mammoth Late Flat Dutch	Ev't.	Sept. 7	123	Nov. 2	179	12	12	11	161	Aug. 23	109	Oct. 25	172	12	10	10	139
Excelsior Flat Dutch	Till.	" 1	117	Nov. 2	179	12	12	11	177	Aug. 31	117	Oct. 11	158	12	12	10½	159
Excelsior Large Flat Dutch	Vick.	" 4	120	" 2	179	12	10	10	120	Sept. 4	121	" 11	158	12	11	10½	142
Excelsior Late Flat Dutch	Till.	" 1	117	Sept. 27	143	12	12	11	154	" 6	123	" 11	158	12	12	10	142
Filderkraut	Hen.	Aug. 20	105	" 27	143	12	12	7	100	" 1	118	Sept. 28	145	12	10	6½	95
"	Sib.	Sept. 1	117	" 4	120	12	12	5½	50	Aug. 18	104	" 8	125	12	11	6½	80
"	Thor.	" 6	122	Oct. 12	158	8	8	8	113	" 18	104	Oct. 11	158	12	12	6¾	90
Fine Large Flat Dutch	"	" 12	128	Nov. 2	179	12	12	10	128	Sept. 4	121	" 25	172	12	11	9½	146
Fottler's Brunswick	Brill.	" 1	117	Sept. 27	143	11	11	10½	151	Aug. 24	110	Sept. 28	145	12	12	10	155
Fottler's Early Brunswick	S. & F.	" 1	117	Oct. 12	158	12	12	12	157	Sept. 4	121	Oct. 11	158	12	12	8½	102
" " "	Till.	" 1	117	Sept. 27	143	12	11	11	154	" 6	123	" 11	158	11	10	11	172
Fottler's Improved Brunswick	Ev't.	" 4	120	Oct. 25	171	12	10	9	145	" 7	124	" 20	167	12	11	8¾	120
" " "	Hen.	" 6	122	" 12	158	12	12	10½	166	" 7	124	" 11	158	12	12	9½	116
" " "	Sib.	Aug. 21	106	Sept. 27	148	12	12	9¼	125	Aug. 23	109	Sept. 28	145	12	12	9½	117
" " "	Thor.	" 21	106	" 27	143	11	11	9½	136	" 27	113	" 28	145	12	12	9	104
" " "	Vick.	" 21	106	" 27	143	11	11	9½	145	" 29	115	Oct. 11	158	12	12	9¼	136
Fottler's Improved Early Brunswick	Greg.	Sept. 1	117	" 27	143	12	10	9½	111	Sept. 7	124	" 11	158	12	12	9½	120
Femel	Vil. '85	Aug. 18	103	Oct. 12	158	12	7	9	62	" 1	118	" 25	172	12	4	7½	34

CABBAGE—SECOND AND THIRD PLANTINGS—EARLY AND LATE VARIETIES (*Continued.*)

	SEEDS PLANTED IN OPEN GROUND.									PLANTS TRANSPLATED FROM COLD FRAME.							
NAME.	Seeds from.	First head formed.	Days from planting.	Date of largest cutting.	Days from planting.	Number of plants.	Number of heads fmd.	Av. diameter of heads.	Av. weight of heads.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants.	Number of heads fm'd	Av. diameter of heads.	Av. weight of heads.
								in.	ozs.							in.	ozs.
Giant of Calabria	Dam.	......	......	......	......	12	0	...	......	Sept. 4	121	Sept. 28	145	12	11	7¾	66
Habas	Vil. '85.	Sept. 6	122	Oct. 25	171	12	9	7½	62	" 10	127	" 25	142	12	8	10	76
Henderson's Early Summer	Brill.	Aug. 25	110	Sept. 4	120	12	8	8½	131	Aug. 9	95	" 8	125	12	8	8½	81
" " "	Ev't.	" 21	106	" 13	129	12	5	9½	134	" 12	98	" 9	126	9	9	7	57
" " "	Greg.	" 21	106	" 13	129	12	12	8½	106	......	......	......	......	......	......	....	......
" " "	Hen '84	" 20	105	" 27	143	12	11	8½	99	Aug. 9	95	Sept. 8	125	12	12	8¾	95
" " "	" '86	" 29	114	" 27	143	12	12	8¾	107	......	......	......	......	......	......	..	......
" " "	Sib.	" 29	114	" 27	143	12	12	10	129	......	......	......	......	......	......	....	......
" " "	Till.	" 20	105	" 27	143	12	12	8	84	Aug. 24	110	Sept. 9	126	12	12	8¾	86
Henderson's Premier	Hen.	" 19	104	" 1	117	12	12	7	62	" 12	98	" 1	118	12	12	6	55
Henderson's Selected Early Jersey Wakefield	"	" 9	94	" 1	117	12	11	5½	42	......	......	......	......	......	......	....	......
Henderson's Selected Late Flat Dutch	"	Sept. 2	118	Nov. 2	179	12	12	9	114	Aug. 24	110	Oct. 11	158	12	12	9½	136
Improved Drumhead	Brill.	" 4	120	Oct. 12	158	12	8	10	118	Sept. 4	121	" 25	172	12	11	10	163
Johnson & Stoke's Earliest	J. & S.	Aug. 30	115	Sept. 22	138	12	11	6	62	......	......	......	......	......	......	....	......
Landreth's Earliest	Land.	" 29	114	" 22	138	12	12	7	48	Aug. 9	95	Aug. 24	110	12	10	5½	49
Landreth's Early Summer Flat Head	"	" 23	108	Oct. 12	158	12	10	6½	60	" 12	98	Sept. 28	145	12	11	7	74
" Large Late Mountain	"	Sept. 15	131	Nov. 2	179	12	11	9	122	Sept. 12	129	Oct 25	172	12	10	9	101
" Large York	"	Aug. 31	116	Sept. 27	143	12	11	8	98	Aug. 24	110	Sept. 9	126	12	11	8	97
" Mammoth Bergen	"	Sept. 9	125	Oct. 25	171	12	11	8½	76	Sept. 9	126	Oct. 25	172	12	11	9	113
Large Bergen Drumhead	Hen.	" 6	122	Sept. 27	143	12	12	9	112	" 4	121	" 11	158	12	8	7	188
" Early Jersey Wakefield	Brill.	Aug. 11	95	" 13	128	12	10	7¾	74	......	......	......	......	......	......	....	......
" Early Schweinfurt	Hen.	" 24	108	" 27	142	12	11	10	139	......	......	......	......	......	......	....	......
" Early York	Ev't.	......	......	......	......	..	..	....	......	Aug. 10	96	Aug. 25	109	12	10	6½	67
" " "	Hen.	" 24	108	Sept. 1	116	12	12	5½	40	......	......	......	......	......	......	....	......
" " "	Thor.	" 30	114	" 4	119	6	6	6	67	......	......	......	......	......	......	....	......
" Flat Dutch	Vick.	......	......	......	......	..	..	....	......	Sept. 12	129	Oct. 25	172	12	6	7½	94
" Jersey Wakefield	Land.	Aug. 30	114	Sept. 27	142	11	11	8	90	Aug. 26	112	Sept. 28	145	12	11	8	124
" Late Drumhead	Hen.	Sept. 4	121	" 27	142	4	4	9	105	Sept. 3	120	Oct. 25	172	10	10	9½	105
" " "	Land.	" 6	119	" 27	142	12	12	8	92	" 4	121	" 11	158	12	10	9	97
" " "	Sib.	" 6	121	" 27	142	5	4	7½	76	" 4	121	Sept. 28	145	12	12	8	89
" " "	Thor.	" 8	123	" 27	142	12	12	8½	85	" 4	121	Oct. 25	172	12	12	9	112
" Late Flat Brunswick	Vil.'85.	" 4	119	" 13	128	2	1	9	116	" 3	120	Sept. 9	126	12	8	9	104
" Late Flat Dutch	Till.	" 4	119	" 27	142	12	4	10	121	" 7	124	Oct. 11	158	12	12	8¾	109

CABBAGE—SECOND AND THIRD PLANTINGS—EARLY AND LATE VARIETIES (*Continued*).

NAME.	SEEDS PLANTED IN OPEN GROUND.									SEEDS TRANSPLANTED FROM COLD FRAME.							
	Seeds from.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants.	Number of heads f'md.	Av. diameter of heads.	Average wt. of heads.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants.	Number of heads fm'd.	Av. diameter of heads.	Average wt. of heads.
								in.	ozs.							in.	ozs.
Large Oxheart	Greg.	Sept. 7	122	Oct. 12	157	9	9	4	33	Aug. 23	109	Sept. 28	145	11	11	7¾	83
“ “	Vil. '85.	“ 9	124	“ 12	157	4	4	8¼	84	“ 23	109	“ 28	145	12	12	7¾	90
Large White Brunswick	Dam.	Aug. 31	115	Sept. 27	142	12	11	8	66	“ 25	109	“ 28	143	11	10	10	149
Large White Solid Magdeburg	Ben.	“ 31	115	“ 27	142	11	10	7½	81	“ 24	108	“ 28	143	11	11	8	99
Large York	Greg.	Sept. 9	124	“ 13	128	2	2	7	84	“ 23	107	“ 9	124	11	6	6	54
“ “	Vil. '85.	“ 9	124	“ 13	128	2	2	4½	30	“ 23	107	“ 9	124	11	6	6	46
Late Bacalan	“	Aug. 15	99	“ 1	116	12	12	6½	71	“ 23	107	“ 9	124	12	12	5½	66
Late American Drumhead	Till.	Sept. 11	126	Oct. 25	170	12	12	9	132	Sept. 12	127	Oct. 25	170	12	12	9	131
Late Flat Dutch	D. of A.	“ 4	119	Sept. 28	143	12	12	8½	113	“ 1	116	Sept. 28	143	12	12	9	133
“ “ “	Vil. '85.	“ 4	119	“ 28	143	12	12	8½	90	“ 1	116	“ 28	143	12	12	8¾	135
Late Mountain	Thor.	“ 7	122	Oct 25	170	12	12	9	109	“ 11	126	Oct. 25	170	12	7	9	115
Lingreville	Vil. '85.	Aug. 31	115	Sept. 10	125	12	12	6½	66	“ 1	116	Sept. 9	124	12	11	5½	46
Little Pixie	Greg.	“ 9	93	“ 1	116	9	9	6	35	....	......	....	......	....	....	....	......
“ “	Sib.	“ 11	95	“ 10	125	12	11	7	65	....	......	....	......	....	....	....	......
Long Island Medium Flat Dutch	Land.	“ 30	114	“ 28	143	12	10	8½	99	“ 4	119	Oct. 11	156	11	9	9½	128
Louisville Drumhead	Brill.	“ 23	107	“ 10	125	12	12	9	125	Aug. 24	108	Sept. 28	143	12	12	10	141
Louisville Early Drumhead	D. of A.	“ 20	104	“ 10	125	12	10	8½	97	“ 24	108	“ 9	124	12	7	8¾	103
Low's Early Peerless	“	“ 7	91	“ 4	119	11	11	8	82	“ 13	97	“ 9	124	12	12	8¾	102
“ “ “	Greg.	“ 12	96	“ 4	119	11	11	8	90	“ 13	97	“ 9	124	12	12	8¾	101
Marbled Burgundy	vil. '85.	“ 31	115	“ 4	119	12	12	4¼	27	“ 31	115	“ 9	124	12	9	5½	41
Marblehead Dutch	Greg.	Sept. 1	116	Oct. 25	170	12	12	8½	100	Sept. 9	124	Oct. 25	170	12	10	10¼	100
Marblehead Mammoth	Sib.	Aug. 30	114	Sept. 28	143	12	12	9½	131	“ 4	119	Sept. 28	143	12	12	8½	103
Marblehead Mammoth Drumhead	Ev't.	Sept 7	122	Oct. 25	170	12	11	9	107	“ 12	127	Oct. 25	170	12	10	8½	105
“ “ “	Greg.	“ 7	122	“ 25	170	12	11	9	122	“ 12	127	“ 25	170	12	10	9½	111
“ “ “	Hen.	Aug. 31	115	“ 25	170	12	11	8	95	“ 7	122	“ 25	170	12	10	7½	96
Maule's Prize Flat Dutch	Maule	Sept, 6	121	“ 25	170	12	12	9	99	“ 4	119	“ 25	170	12	10	7¾	128
Maule's Sure Head	“	“ 7	122	“ 25	170	12	11	9	75	“ 1	116	“ 25	170	12	11	9	102
Newark Early Flat Dutch	Brill.	Aug. 10	94	Sept. 10	125	12	12	8	75	Aug. 23	107	Sept. 9	124	11	10	7¾	85
“ “ “ “	Greg.	“ 21	105	“ 10	125	12	12	8	80	“ 12	96	“ 9	124	12	12	7¾	81
New No. 1 Earliest	Burpee	“ 10	94	“ 21	136	12	12	6½	72	“ 21	105	“ 11	126	12	12	5¾	54
Nonpareil	Vil. '85.	“ 6	90	“ 9	124	12	11	5½	38	....	......	....	......	....	....	....	......
Nonpareil Early	Greg.	“ 12	96	“ 10	125	12	11	6½	49	....	......	....	......	....	....	....	......
Oxheart (French)	Land.	“ 11	95	“ 10	125	12	12	7	63	“ 25	109	Sept. 9	124	12	10	4½	57
Pointed Headed Filderkraut	“	“ 18	102	“ 4	119	11	11	8	80	Sept. 8	123	Oct. 25	170	12	11	7	108

CABBAGE—SECOND AND THIRD PLANTINGS—EARLY AND LATE VARIETIES (*Continued*).

NAME.	SEEDS PLANTED IN OPEN GROUND.									PLANTS TRANSPLANTED FROM COLD FRAME.							
	Seeds from.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants.	Number of heads fmd.	Avg. diam't'r of heads.	Avereage wt. of Heads.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants.	Number of heads fmd.	Avg. diam't'r of heads.	Avg. weight of heads.
								in.	ozs.								
Pomeranian	Vil. '85.	Aug. 18	102	Oct. 25	170	12	11	7	111	......	......	......	......	......	......	......	......
Premium Flat Dutch	Brill.	Sept. 4	119	" 25	170	11	11	10	131	Sept. 6	121	Oct. 25	170	12	12	9½	129
" " "	Ferry.	" 4	119	" 25	170	12	8	9	121	" 8	123	" 25	170	11	10	7½	69
" " "	Greg.	" 4	119	" 25	170	12	10	9½	156	" 8	123	" 25	170	12	8	8¾	119
" " "	Hen.	" 4	119	Sept. 28	143	12	10	8	105	" 6	121	" 25	170	12	11	8½	104
" " "	Maule.	" 4	119	Oct. 25	170	12	11	8¾	117	" 8	123	" 25	170	12	11	7¼	84
" " "	Till.	" 4	119	" 25	170	12	12	10	95	" 8	123	" 25	170	12	11	8¼	101
" " "	Vick.	......	......	......	......	......	......	......	......	" 10	125	" 25	170	11	9	8¾	101
Quintal Drumhead	Sib.	Sept. 15	130	Oct. 25	170	12	11	8½	107	" 14	129	" 25	170	12	10	8	68
Rawson's Early Summer	Raw.	Aug. 14	98	Sept. 1	116	12	12	8	78	Aug. 25	109	" 25	170	11	10	7¾	72
Round Schweinfurt	Land.	Sept. 1	116	" 22	137	12	11	11	123	Sept. 8	123	Sept. 28	143	11	10	9¾	114
Russian Flat Giant	Ben.	Aug. 24	108	" 1	116	7	7	8½	80	" 9	124	" 28	143	12	12	7¾	66
Russian Round Giant	"	" 3	114	" 28	143	12	12	9½	115	" 4	119	" 28	143	11	11	7	75
St. Denis Drumhead	Vil. '85.	Sept. 6	119	Oct. 25	170	12	11	9	114	" 7	122	Oct. 12	157	12	12	7½	82
St. Denis Large Early Drumhead	Land.	" 6	119	" 25	170	11	10	8¾	103	" 7	122	" 12	157	12	11	9	105
St. John's Day Early	Sib.	Aug. 6	88	Aug. 10	92	12	12	6⅓	45	......	......	......	......	......	......	......	......
" " "	Vil. '85.	" 6	88	" 10	92	12	12	6	39	......	......	......	......	......	......	......	......
St. Lohn's Day Late	"	" 20	102	Sept. 1	116	12	12	7	59	Sept. 4	119	Sept. 28	143	12	11	7½	75
Schweinfurt	"	Sept. 1	114	" 22	137	12	11	11	134	......	......	......	......	......	......	......	......
Schweinfurt Quintal	Greg.	" 1	114	" 22	137	8	5	13	138	Sept 6	121	Sept. 28	143	11	9	9¼	135
Selected Very Early Jersey Wakefield	Land.	Aug. 5	89	Aug. 31	115	12	12	5¾	54	Aug. 5	91	" 8	121	12	12	7½	88
Short Stem Drumhead	Brill.	Sept. 4	117	Oct. 25	170	12	11	10	116	Sept. 20	135	Oct. 25	170	12	11	8½	117
Sibley's Premium Large Late Flat Dutch	Sib.	" 7	120	" 12	155	12	5	10	148	" 7	122	" 25	170	12	10	10	122
Silverleaf Drumhead	Brill.	" 20	133	Nov. 1	177	12	9	8½	91	" 28	143	" 25	170	12	7	9¼	109
" "	Hen.	" 20	133	Oct. 12	155	7	7	7¼	133	" 28	143	" 25	170	12	11	8¼	102
" "	Thor.	" 7	120	" 12	155	12	5	10	59	" 8	123	" 25	170	12	11	8½	103
Stone Mason	Brill.	" 7	120	" 25	168	12	12	8½	113	......	......	......	......	......	......	......	......
" "	Greg.	" 7	120	Nov. 2	176	7	7	7	137	......	......	......	......	......	......	......	......
" "	Hen.	" 7	120	" 2	176	12	10	8	96	......	......	......	......	......	......	......	......
Stone Mason Drumhead	Sib.	" 1	114	Oct. 25	168	12	12	8⅓	83	......	......	......	......	......	......	......	......
Suabian	H. & S.	" 7	120	" 25	168	12	11	6½	99	......	......	......	......	......	......	......	......
Sugar Loaf	Greg.	Aug. 23	105	Sept. 28	141	11	11	5⅓	49	......	......	......	......	......	......	......	......
" "	Vil. '85.	" 21	103	" 28	141	8	8	6	54	......	......	......	......	......	......	......	......
Tourleville	Greg.	Sept. 28	141	Oct. 25	168	12	10	6	53	......	......	......	......	......	......	......	......

CABBAGE—SECOND AND THIRD PLANTINGS—EARLY AND LATE VARIETIES (*Continued*).

NAME.	SEEDS PLANTED IN OPEN GROUND.									SEEDS TRANSPLANTED FROM COLD FRAME.							
	Seeds from.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants.	Number of heads fm'd.	Av. diameter of heads.	Average wt. of heads.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants.	Number of heads fm'd.	Av. diameter of heads.	Average wt. of heads.
								in.	ozs.							in.	ozs.
Tourleville	Vil. '85.	Aug 24	106	Sept. 28	141	7	6	6½	56	....	....	....	....	....	....	....	....
True Early Jersey Wakefield	Brill.	" 1	92	Aug. 31	116	12	12	5	45	....	....	....	....	....	....	....	....
" " " "	Till.	" 11	96	" 31	116	12	12	6½	64	....	....	....	....	....	....	....	....
Ulm Quintal	Ben.	Sept. 1	114	Sept. 28	141	12	11	8	92	....	....	....	....	....	....	....	....
Vaugirard	Vil. '86.	" 1	114	" 28	141	5	1	11	153	....	....	....	....	....	....	....	....
Very Early Etampes	Greg.	Aug. 11	96	" 4	120	12	12	7	66	....	....	....	....	....	....	....	....
" " "	Vil. '85.	" 31	97	Aug. 31	116	11	11	6	50	....	....	....	....	....	....	....	....
Vilmorin's Early Flat Dutch	Greg.	Sept. 1	114	Sept. 10	123	12	12	6	47	....	....	....	....	....	....	....	....
Warren	"	" 4	117	Oct. 12	155	12	11	8½	107	....	....	....	....	....	....	....	....
Wheeler's Cocoanut	"	Aug. 21	103	Sept. 28	141	12	12	5	37	....	....	....	....	....	....	....	....
Winnigstadt	Land.	" 20	102	Oct. 12	155	8	8	6	63	....	....	....	....	....	....	....	....
"	Vil. '85.	" 29	111	" 12	155	12	11	7	66	....	....	....	....	....	....	....	....
RED CABBAGES.																	
Berlin Large Dark Red	H. & S.	" 11	95	Sept. 10	125	12	12	5½	48	Aug. 23	107	Sept. 9	124	12	12	5⅓	43
Dark Red Drumhead	Vil. '85.	" 30	114	Oct. 1	146	12	6	7	93	" 26	110	" 9	124	11	10	6½	69
Dark Red Pointed Headed	"	" 21	105	Sept. 28	143	12	11	5½	54	" 29	113	" 9	124	12	11	5	45
Earliest Blood Red Erfurt	Sib.	" 31	115	Oct. 20	165	12	10	4	26	....	....	....	....	....	....	....	....
Early Blood Red Erfurt	Greg.	" 6	90	Sept. 1	116	12	11	5	32	....	....	....	....	....	....	....	....
" " " "	Hen.	" 10	94	" 8	125	12	12	4¼	28	....	....	....	....	....	....	....	....
Early Dark Red Dutch	Vil. '85.	" 10	94	Oct. 20	165	11	11	5	45	....	....	....	....	....	....	....	....
Early Dark Red Erfurt	Greg.	" 6	90	Sept. 1	116	12	1	4½	26	....	....	....	....	....	....	....	....
" " "	Vil. '85.	" 7	91	" 1	116	12	11	5	28	....	....	....	....	....	....	....	....
Garfield Pickling	Greg.	Sept. 6	121	" 28	143	12	11	4	27	Sept. 21	136	Oct. 25	170	12	11	3½	21
Mammoth Rock Red	Hen	Aug. 29	113	" 28	143	12	11	6	52	" 22	137	" 25	170	11	10	6½	56
Red	Thor.	" 29	113	" 28	143	12	12	6½	60	Aug. 30	114	" 25	170	12	12	6¾	79
Red Drumhead	Greg.	Sept. 4	119	Oct. 25	170	12	12	7	73	" 30	114	" 25	170	9	9	6	52
Red Dutch	D. of A.	" 4	119	" 25	170	12	12	6½	89	....	....	....	....	....	....	....	....
"	Ev't.	....	....	....	....	....	....	....	....	Sept. 4	119	" 25	170	11	8	6	66
"	Greg.	Aug 29	113	Oct 25	170	12	12	6	60	" 7	122	" 25	170	8	7	3½	55
"	Hen.	Sept. 4	119	" 25	170	12	12	5	44	" 4	119	" 25	170	10	10	4¾	35
"	Land.	" 4	119	" 25	170	12	11	5½	70	" 4	119	" 25	170	12	10	3¾	40
" Pickling	Sib.	" 4	119	" 25	170	6	6	6	67	....	....	....	....	....	....	....	....

Note. In addition to the above, six rows of the Green Glazed Cabbage were grown, but none of the plants formed a head.

CABBAGE—SNCOND AND THIRD PLANTINGS—EARLY AND LATE VARIETIES (*Concluded.*)

SAVOY CABBAGES.	SEEDS PLANTED IN OPEN GROUND.									PLANTS TRANSPLANTED FROM COLD FRAME.							
	Seeds from.	First head formed.	Days from planting.	Date of largest cutting.	Days from planting.	Number of plants.	Number of heads f'm'd	Av. diameter of heads.	Av. weight of heads.	First head formed.	Days from planting.	Date largest cutting.	Days from planting.	Number of plants.	Number of heads f'm'd	Av. diameler of heads.	Av. weight of heads.
								in.	ozs.							in.	ozs.
Drumhead	Greg.	Sept. 1	116	Oct. 25	170	12	12	7½	77	Sept. 4	119	Oct. 25	170	12	11	6½	56
Early Yellow Frankfort	Dam.	Aug. 23	107	Sept. 22	137	12	12	5¾	51	" 1	116	" 25	170	12	6	5	28
Golden	Vil. '85.	Sept. 1	116	Oct. 25	170	12	11	5½	41	Oct. 20	165	" 25	170	12	5	6	47
Green Curled	Land.	" 7	122	" 25	170	11	11	5	42	" 1	146	" 25	170	12	12	5¾	44
" Globe	Sib.	......	......	......	......	..	..	..	.....	" 25	172	" 25	172	12	6	7	62
" "	Vil. '85.	Oct. 25	170	Oct. 25	170	12	7	9	36	Sept. 28	143	" 12	157	11	3	7	64
Groot's Favorite	Dam.	Aug. 4	88	Aug. 24	108	1	1	5¾	40	......	......	......	......	...	...	...	...
Improved American	Greg.	Sept. 4	119	Sept. 28	143	12	12	8½	115	Sept. 7	122	Oct. 25	170	12	7	7½	65
" "	Sib.	Oct. 1	146	Oct. 25	170	11	12	7	76	" 7	122	" 25	170	11	8	8½	95
" " Drumhead	Hen.	Sept. 7	122	" 25	170	12	12	7	72	" 4	119	" 25	170	12	9	7½	68
Large Curled Wilson	Dam	" 9	124	" 25	170	12	12	7½	64	......	......	......	......	...	...	...	...
Large Late Hardy Winter Drumhead	Vil. '85.	Oct. 1	146	" 25	170	12	11	7½	64	Oct. 1	146	Oct. 25	170	12	2	7½	70
Large Vertus Drumhead	" "	Aug. 30	114	Sept. 28	143	12	12	9	103	Sept. 28	143	" 25	170	12	12	10½	114
Late Drumhead	Thor.	" 31	115	Oct. 12	157	12	8	8	55	" 7	122	" 12	157	12	7	7	68
Long Headed,	Vil. '85.	Sept. 28	143	" 25	170	12	10	5½	41	" 24	139	" 25	170	10	10	6	47
Netted	Hen.	" 4	119	Sept. 28	143	12	8	8½	79	" 7	122	" 12	157	11	8	7	65
Norwegian	Vil. '85.	" 21	136	Oct. 25	170	12	7	7	51	" 27	142	" 25	170	11	9	7¾	66
Small Early Ulm	" "	Aug. 10	94	Sept. 28	143	12	12	5	29	......	......	......	......	...	...	...	...
Strasburg	H. & S.	" 26	110	Oct. 12	157	12	10	5	31	" 21	136	Oct. 12	157	11	11	5½	33
Tours	Vil. '85.	Sept. 20	135	Sept. 28	143	12	2	6½	66	" 21	136	" 25	170	12	8	5½	31
Ulm	Land.	Aug. 7	91	" 22	137	12	10	5	32	Aug. 18	102	Sept. 22	137	12	9	5	34
Very Early Paris	Greg.	" 9	93	Aug. 31	115	12	12	6	45	......	......	......	......	...	...	...	...
" " "	Vil. '85.	" 9	93	Sept. 28	143	12	7	6	47	......	......	......	......	...	...	...	...
Victoria	" "	Sept. 7	122	Oct. 25	170	12	4	6	44	......	......	......	......	...	...	...	...

A brief study of the table makes it evident that twelve plants from each sample of seed are not sufficient to warrant many deductions as to which varieties would give the best results to the practical gardener. Indeed this was not the Director's object in making the trial. The cabbages were grown for the purpose of securing descriptions of the different varieties, and determining the synonyms. As an illustration of the capriciousness of so small a number of plants, I note that in the first planting, the rows of St. John's Day Early from Sibley and Vilmorin were surpassed in earliness by forty-seven other rows, while in the planting made in the open ground they were the earliest of the smooth leaved sorts.

By massing the results obtained from the plantings of the same variety from different seedsmen, the number of plants becomes sufficiently large to discuss. A comparison of two prominent early varieties is therefore made, as follows :

A COMPARISON OF EARLY WAKEFIELD AND ETAMPES.

	Number of rows.	Whole number of plants.	Per cent. of heads formed.	Average time to first head.	Average time to largest cutting.	Average diameter of heads.	Average weight of heads.
				days	days	in.	ozs.
Early Wakefield—seeds planted in place	10	118	95.8	96.3	119	6.6	64
Early Wakefield—plants started in cold frame.	6	71	95.8	93.7	120	6.7	70.6
Etampes—seeds planted in place	7	83	97.6	98.5	118	5.9	50.4
Etampes—plants started in cold frame	3	33	88	98.7	120	6	55.3

The Etampes has been very often claimed by seedsmen to be earlier than the Early Wakefield. From the table it appears that at the Station, it was not only no earlier but the heads were smaller and lighter than in the latter variety.

DO TRANSPLANTED PLANTS HEAD BETTER THAN OTHERS ?

It has often been claimed that the act of transplanting cabbage plants exerts a beneficial influence upon their heading qualities. The second and third plantings in our test of varieties gave an opportunity to make a comparison in this respect, as the second planting was made in boxes in the cold frame May 6–10, and the third in the open ground May 7–10. It is thus possible to compare 166 rows of transplanted plants with the same number of rows grown "in place," the varieties being identical, and the seed being taken from the same packages. The results of such a comparison are as follows :

	Average time to first head. Days.	Average time to largest cutting. Days.	Average diameter of heads. Inches.	Average weight of heads. Ounces.	Per cent of plants that headed.
Second planting, plants transplanted...	114.95	140.89	7.55	89.1	86.76
Third planting, plants grown in place.	116.17	141.90	7.81	90.	90.16

It is evident that, in this case, the transplanting shows no beneficial effect. The little difference is in favor of the plants grown "in place."

CABBAGE PLANTS FROM GREEN SEED.

In the Station report for 1884, p. 211, is noted the result of an experiment in the use of slightly green seed, in which it appears that the plants from the green seed vegetated better, and their heads matured earlier, and were larger than those from ripe seed. The experiment was repeated the past season on a larger scale. In the summer of 1885 the seed stalks of a plant of the Winnigstadt cabbage, of which the pods were fully grown but had not commenced to turn yellow. were cut and hung up in a dry room, where they were left until the pods were sufficiently dry to shell. Last spring a quantity of this seed, with some fully ripe seed of the same variety, was planted in the cold-frame, and a plat containing one-twentieth of an acre was set out with the plants, those from the green and ripe seed occupying alternate rows.

Of each selection, 176 plants were set. Those from the ripe seed formed 140 heads, averaging 72.8 ounces in weight, while those from the green seed formed only 88 heads, averaging 55.8 ounces in weight.

In this experiment, the result is strongly against the green seed. Much, however, may depend upon the degree of immaturity. It is possible that while seed that is very slightly unripe may produce better results than that fully ripe, more immature seed might act in the opposite way.

GROWING CABBAGE PLANTS FROM SLIPS.

In the Station report for 1884, p. 212, an experiment is noted in growing the cabbage from leaf cuttings. The experiment was made the past season on a larger scale. It was found possible to obtain thrifty plants in this way in a shorter time than from seed. But a small proportion of the slips formed plants, however, and when removed to the open ground these seemed less hardy than those grown from seed. The assumption that plants grown in this way would vary less than those grown from seed was not sustained, for the plants grown from the slips were by no means uniform, nor did they head as well as did the parent plant.

In this experiment, the slips were made from the stem leaves of a plant that was forming the flower stalk. The experiments have shown that slips taken from a plant that is in a condition of growth form the bud sooner than those from a dormant plant.

A DESCRIPTION OF THE PRINCIPAL VARIETIES OF THE HEADING CABBAGE.

Following the plan of the Director, an attempt is here offered of a description and classification of the principal varieties of the heading cabbage. Much difficulty was anticipated in the work, and much has been realized. The names and varieties are less numerous than in some other vegetables, but the extreme variability often shown in the plants from the same sample of seed, and the difficulty of deciding the amount of variation admissable within a variety, have been a constant source of embarrassment. The heading cabbage appears to be extremely subject to variation, a peculiarity for which the seed grower cannot be held entirely responsible.

The attempt to describe variables in terms sufficiently accurate to be of value in recognizing varieties is necessarily accompanied by difficulty. To pronounce closely related forms, which continually vary into each other as synonyms, which we must do if we follow strictly the spirit of botany, is to ignore the distinctions of different strains, a distinction which is often of very great importance to the market gardener. This attempt is offered, not because it is believed to be faultless, but because it is the best that I have been able to make.

Thanks are due to Prof. W. W. Tracy, of Messrs. D. M. Ferry & Co., Detroit, Mich.; to Mr. A. G. Tillinghast, of Padilla, W. T.; to Hon. J. J. H. Gregory, of Marblehead, Mass., and Mr. Francis Brill, of Riverhead, L. I., for valuable information and assistance in relation to varieties.

VARIETIES.

In separating the cabbages into their varieties, not simply the head, but all of the visible characters have been taken into account, and it has seemed best not to accept much variation in a given character. Some of our horticultural writers have admitted much diversity in this respect, but if we allow this in one character we cannot consistently refuse to allow it in all, and this would render descriptions valueless, if not absurd. Thus we find in the writings of a prominent grower of, and writer on cabbages: "In the Wakefield cabbage, the conical and flat are both normal." The same author; in speaking of the Stone Mason cabbage, says: "The color of the leaves varies from a bluish-green to a pea-green, and the structure from nearly smooth to much blistered." Another well-known seed grower says of the Jersey Wakefield cabbage: "It must be admitted it presents many conditions; it is early, late, pointed, round, rough and smooth leaved." Admissions like these would seem to prove beyond question that the cabbage under consideration is either very poorly fixed, or else from having been grown under very unfavorable conditions, or through mixture with other varieties, it has been permitted to deteriorate. We cannot of course ignore the inherent variability of plants, but the seed grower should certainly have an ideal form for his varieties, and this ideal should include not simply the part for which the plant is grown, but the secondary characters[1] as well. It is probable that through the little understood law of co-relation of growth, the part of the vegetable used is influenced by the secondary characters, and that the highest excellence can only be attained by paying careful attention to these, as well as to the part for which the plant is grown. It is highly important also that different seed growers should work towards the same ideal, and the present attempt is designed to aid them in doing this.

In deciding from our variable plantings what particular form should constitute the true variety, it has been assumed that the majority of the plants were correct. As an illustration of the variability in plants of the same variety from the same seedsman, and from different seedsmen, a table is here presented showing the results of a comparison of the secondary characters in the Premium Flat Dutch cabbage:

Seeds from.	Numbers of Plants.	Plants deep bluish-green.	Plants pale bluish-green.	Plants much blistered.	Plants little blistered or smooth.	Border of leaves ruffled.	Border of leaves undulate.	Border of leaves plain.	Lower leaves petioled.	Lower leaves not petioled.
Brill.	23	15	8	5	18	17	5	1	5	18
Ferry.	21	17	4	11	10	12	9	..	4	17
Greg.	22	18	4	8	14	18	4	..	4	18
Hen.	23	19	4	9	14	19	4	..	3	20
Maule.	11	11	0	6	5	10	1	..	0	11
Till.	24	21	3	8	16	18	6	..	1	23
Vick.	22	18	4	7	15	13	6	3	3	19
Total	146	119	27	54	92	107	35	4	20	126

---

[1] The term "secondary characters" is here used to mean all other characters except those relating to the head.

From this it is evident that the foliage of this variety should be of a deep bluish-green color, slightly blistered or smooth, with ruffled borders, and the lower leaves not petioled. All plants, therefore, that did not present these characters, were considered as being off type, and hence were not used in the description: Very many of our cabbages were tabulated in the same manner. As far as practicable the results thus obtained have been supplemented by comparison with the printed descriptions and illustrations of horticultural works, and seedsman's catalogues, and by correspondence with experienced seed growers.

SUB-VARIETIES.

Several cabbages, as for instance the Surehead and Bergen Drumhead, known to seedsmen under different names, presented such close resemblances that many of the plants from one could have been placed in the other without the possibility of detection. Yet a difference was observable between the rows taken as a whole, and frequently this was of a character that materially influenced the intrinsic value of the two rows. It seemed hardly possible to describe such as distinct, and quite improper to pronounce them synonyms. It has seemed best, therefore, to follow Vilmorin in recognizing *sub-varieties* or *strains* in some cases, permitting the strain to retain the name under which it has been generally known. This distinction has long been recognized by seedsmen, and probably could not be wisely ignored, because improvement must generally come through slow gradations, and to refuse to recognize such incipient varieties would be detrimental to progress. The names of such strains in the described list are printed in italics.

CLASSIFICATION.

As an aid in identifying varieties, we have adopted, with slight change, a classification proposed by M. Augustin P. De Candolle, a learned French botanist, in a paper read before the London Horticultural Society, Aug. 7, 1821. This plan separates the heading cabbages into two principal classes, based upon the degree of blistering of the foliage, or in other words, upon the relative development of the parenchyma and veins. A similar division has long been recognized by horticultural writers and seedsmen, the smooth or less blistered sorts being known as *cabbages*, and the more blistered ones as *Savoys* or *Savoy cabbages*. M. DeCandolle inclines to consider these classes as distinct races,[1] and ranks the Savoy class as being botanically intermediate between the tall or Cavalier cabbage and the common or smooth leaved cabbage.[2] However this may be, the distinction between them is by no means clearly marked. Many of the so-called smooth-leaved class are considerably blistered, and certain varieties commonly classed with the Savoys are not more blistered than others that have been placed in the smoother class. In this article the division followed by M. Vilmorin in *Les plantes potagères* has been used.

The properties of these two classes differ in some respects. The smooth leaved cabbages are on the average more rapid in growth, grow to a larger size, and form larger and more compact heads than do the Savoys, while the latter, on the other hand, are the more tender and more delicately flavored. In our experience at the Station, the Savoys have proved less reliable for heading than the varieties of the other class.

M. DeCandolle further divided the smooth leaved class into five divisions, which he calls varieties, based upon the shape of the head. It has seemed well to extend this division so as to make it include the Savoy class as well. Although at present the forms of the head in the latter are less numerous than in the smooth leaved class, it is possible that new varieties may appear of other forms, and our scheme should be applicable to future as well as to present varieties.

These divisions as proposed by M. DeCandolle are:

1st, the flat or oblate headed cabbages, (Fig. 3, Page 202);

2d, the round headed, (Fig. 4);

3d, the egg shaped, or obovate headed, (Fig. 5);

4th, the elliptical headed, (Fig. 6); and

5th, the conical headed cabbages, (Fig. 7).

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[1] The word race is apparently used in the paper under consideration as indicating a group of varieties.

[2] M. De Candolle gave botanical names to these classes, calling the smoother leaved class *Brassica oleracea capitata*, and the blistered leaved class *B. oleracea bullata*. The first class is called by M. Vilmorin "*Choux pommes a feuilles lisse*,"—Smooth leaved heading cabbages; and the second, "*Choux de Milan*,"—Milan cabbages.

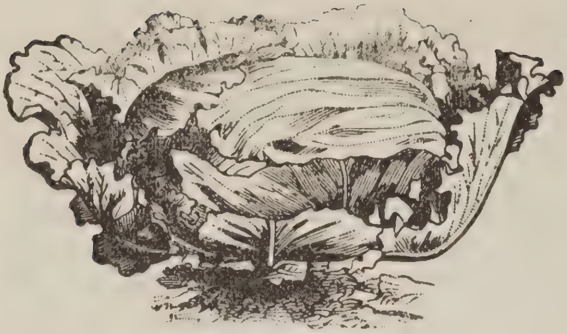

FIG. 3.

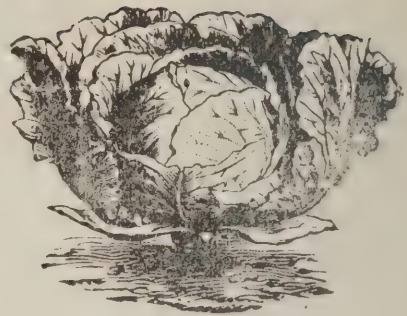

FIG. 4.

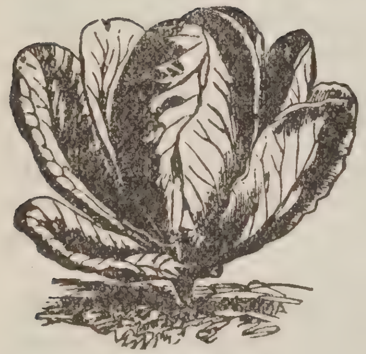

FIG 5.

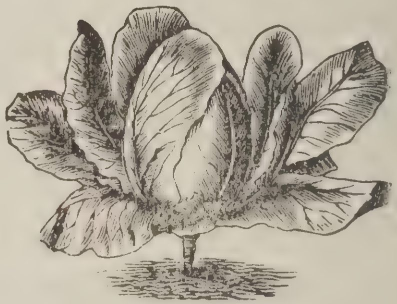

FIG. 6.

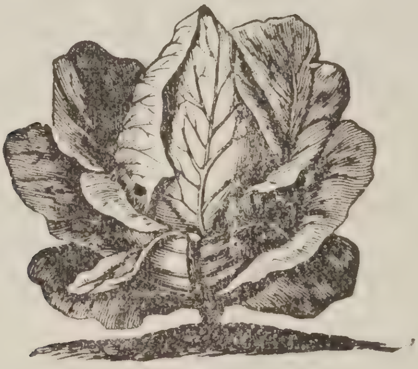

FIG. 7.

These divisions seem rather arbitrary, for we have heads of every possible shade of gradation between the flattest, and the most oblong conical head. The properties of the cabbage seem to depend more upon the coloring of the foliage than upon the form of the head, and hence a division based upon color would seem to logically precede the one based upon the form of the head. It has, however, seemed best to follow M. DeCandolle in this respect.

The form of the head appears to depend chiefly upon the degree of curvature of the midrib, or what is the same thing, upon the angle which the leaves assume with reference to the stalk. It is also probably influenced somewhat by the form of the leaves. In those cabbages of which the leaves tend to spread out upon the ground, those forming the head must make a complete semi-circle in order to meet at the top. If the leaves grow very spreading and are roundish, as in Fottler's Brunswick, the ends do not always come together, hence the top of the head does not grow so rapidly as the sides, and a flat or oblate head is the result. On the other hand, if the leaves grow nearly erect, as in the Pomeranian cabbage, a slight curvature of the lower part of the midrib is sufficient to bring the ends together, and a conical head is the result.

In each of the divisions based upon the form of the head, we may assume to be possible both red and green varieties; hence the last subdivision is that based upon the color of the foliage. There are as yet no red Savoys, but we do not know that such varieties are impossible, as some of the red cabbages show a tendency to blister. A further subdivision might be made, based upon the degree of undulation of the borders of the leaves, but as this is often extremely variable, it has not seemed wise to extend the scheme. The complete classification is therefore as follows:

The heading cabbage.	A. Foliage smooth, or but little blistered.	I. Head distinctly flattened.	Foliage green.
			“ more or less washed with red or purple.
		II. Head round, or nearly so.	Foliage green.
			“ more or less washed with red or purple.
		III. Head egg-shaped, the smaller end downward.	Foliage green.
			“ more or less washed with red or purple.
		IV. Head elliptical.	Foliage green.
			“ more or less washed with red or purple.
		V. Head conical.	Foliage green.
			“ more or less washed with red or purple.
	B. Foliage much blistered.	I. Head distinctly flattened.	Foliage green.
		II. Head round or nearly so.	Foliage green.
		III. Head egg-shaped, the smaller end downward.	Foliage green.
		IV. Head elliptical.	Foliage green.
		V. Head conical.	Foliage green.

NAMES AND AUTHORITIES.

When a choice of names appeared, the shortest or best known one has been adopted. In no case has a name been changed. The names of seedsmen attached to varieties have generally been omitted, because in the intercourse of gardeners and seedsmen, these additions are generally dropped by common consent. Care has been taken, however, to give credit to originators or introducers of varieties, so far as information made this possible.

The authority is appended for every name and synonym used. An authority printed in small capitals shows that the variety or strain has already been described by the au-author, or in the work cited. This furnishes a rather complete bibliography of the varieties of the heading cabbage.

The date or dates appended show that the authority is a seedsman from whom the seed was procured, under the name and in the year or years specified. An authority printed in Roman letters, without a date, indicates that the name or synonym to which it is appended has been already used by the authority cited.

All synomyms that have been determined, or verified in the Station garden, are printed in italics. In cases of uncertainty, the name is followed by the interrogation point. It is understood that plants of all names or synonyms to which dates are attached have been grown at the Station, and have furnished the data for the descriptions. Synonyms not printed in italics have not been verified, and are given only on the authority appended to them.

SYNONYMS.

It is scarcely possible to apply the term synonym with reference to the cabbage and other vegetables propagated from seeds, in the strict sense that it is used with relation to plants propagated by division. In the case of vegetables, variability is the rule, and the precise form represented by a given sample of seed depends to a considerable extent upon the care in selection exercised by the seed grower, and upon the ideal of the variety in his own mind.

It is not to be understood, therefore, that the plants grown from the samples of seed bearing the names included in the list of synonyms of any given variety were in every case absolutely identical, nor that one did not yield a more satisfactory crop than another in some cases. It is not declared that because "Burpee's Superior Late Flat Dutch," and "Henderson's Selected Late Flat Dutch" are described as synonyms of Premium Flat Dutch, that all the careful selection that may have been expended upon these particular strains is ignored, or that the effects of this care have not been seen in the plants. They are placed as synonyms because they are not sufficiently distinct to be described as separate strains. In very many cases the effects of careful selection, or the want of it, were clearly marked in the plants; effects which are frequently shown by the figures of the table. But it would be quite impossible to intelligibly describe the minute characters that constitute the differences between such closely allied forms. Unfortunately, my experience with the varieties has been chiefly limited to garden tests. Could the thorough experience of the market gardener and seed grower have been added to this, many characters might doubtless have been better defined.

EXPLANATION OF THE TERMS USED IN DESCRIBING VARIETIES.

The terms used in the descriptions are in the main the same as those used in the report for 1885[1] in describing the varieties of lettuce, and they have the same signification. In order to make some of these terms more definitely understood, drawings are given illustrating certain characters. A *spoonform* leaf having a *ruffled* border, and a *recurved* or *reflexed* apex is shown at Fig. 8. When the border is slightly waved, but not sufficiently to form folds it is called *undulate*. A leaf having its upper surface dishing, but of which the folds in the border are so coarse and large as to distort its outline, is called *angular spoonform*. At Fig. 9 is shown a leaf that is spoonform at the center, but of which the borders curve backward. Such leaves are termed *reflexed spoonform*. When the whole limb of the leaf curves backward from the midrib, causing the latter to form a straight line, or to curve in the opposite direction from that shown in the cut, the leaf is said to be *reflexed*. A leaf is said to be *petioled* when it is not sessile upon the stem, but is projected a little, the midrib being nearly or quite naked at the base.

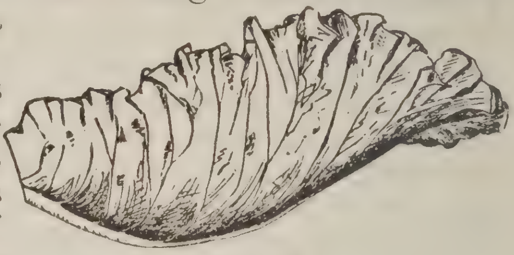

FIG. 8.

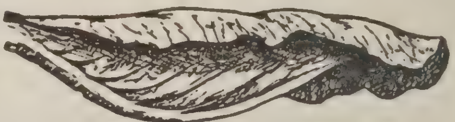

FIG. 9.

EXPLANATION OF ABBREVIATIONS USED IN THE DESCRIPTINS.

For a list of the abbreviations of the names of seedsmen see the close of the report of the Horticulturist in this volume.

Abbreviations for the names of authors and works upon gardening are used as follows :

A. de Cl.—*Album des Clichés*, Vilmorin, Andrieux et Cie., 1883.

Brill—Farm Gardening and Seed Growing, Francis Brill, 1872.

Burr, or Burr—Field and Garden Vegetables of America, Fearing Burr Jr., 1863.

Gar. Chron.—Gardeners' Chronicle, London, Eng.

Greg.—Cabbages and how to grow them, J. J. H. Gregory, 1870.

Hen.—Gardening for profit, Peter Henderson, 1867.

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[1] See report N. Y., Agricultural Experiment Station for 1885, pp. 138-139.

Land.—The Cabbage Family, D. Landreth & Sons, 1877.
Thomp.—Robert Thompson, correspondence Gardeners' Chronicle.
Veg. Gar.—The Vegetable Garden, the English edition of *Les plantes potagères*, edited by William Robinson, 1885.
Vil.—*Les plantes potagères,* Vilmorin, Andrieux et Cie., 1883.
White—Gardening for the South, William N. White, 1868.

Additional abbreviations are employed as follows :

Cat.—Catalogue.
(d.) "from description"—applied to names or synonyms that have been identified from a printed description.
Fr.—French.
Ger.—German.
Holl.—Holland.
Ital.—Italian.
Port.—Portugese.
Syn.—Synonym.

SYNOPSIS OF CLASSIFICATION.

A. Foliage smooth, or but little blistered.	Nos.	1-70	incl.
I. Heads more or less distinctly flattened	"	1-36	"
II. Heads round or nearly so	"	37-48	"
*Foliage green	"	37-43	"
† " distinctly washed with red or purple	"	44-48	"
III. Head egg shaped, the smaller end downward	No.	49.	
IV. Heads elliptical	Nos.	50-51	incl.
V. Heads more or less distinctly conical	"	52-70	"
*Foliage green	"	52-69	"
† " washed with red	No.	70	

B. Foliage more or less strongly blistered.	Nos.	71-83	incl.
II. Heads round or nearly so	"	78-81	"
IV. Heads elliptical	No.	82	
V. Heads conical	"	83	

N. B.—*The names are arranged in alphabetical order, under their several heads.*

Note.—In the descriptions following, the notes in regard to the size of the head, and the season of maturity of the different varieties and sub-varieties are given only in a general way. By reference to the tables on pages 186 and 195, the reader may find the exact results secured at the Station in these particulars.

A. Foliage smooth, or but little blistered.

I. Heads more or less distinctly flattened.

NO. 1. ALL SEASONS, GREG., '86.

Appears closely allied to the St. Denis. It has rather less lustre than that variety, but in other respects the resemblance is remarkably close. Introduced by Mr. Gregory in 1886, and is recommended both as an early and late cabbage.

Said to be a cross between "Flat Dutch" and "Drumhead."

Figured correctly in Gregory's catalogue 1886.

NO. 2. AMAGER, VIL. (d.)

Syn. *Amager Danish Winter Round*, Ben., '86; Ger. *Amager rundes danisches winter Kraut oder Kopfkohl*, Ben., '86.

Plant of medium size, but tall, the stem at least four inches long below the leaves; foliage rather pale bluish-green; head small, slightly flattened, extremely compact, scarcely paler than the outer leaves, which are roundish or oval, flat or spoon-form, slightly blistered, with plain or undulate borders.

A very hardy Danish variety that has few desirable qualities for our climate.

NO. 3. BERGEN DRUMHEAD; BRILL; BURR; GREG.; HEN.

Syn. Great American, Burr; Large Bergen, Burr; *Landreth's Mammoth Bergen*, Land., '86, *Large Bergen Drumhead*, Hen., '86; Large German Drumhead, Burr; *Large Late Bergen*, Thor., '83; Quintal, of Vil., (incorrectly), Burr.

Plant of the largest size, spreading; foliage of a very deep bluish-green, much blistered, leaves with strongly ruffled borders; head large, more or less flattened, pale green, compact; stem short.

This cabbage is very reliable for heading, keeps well, and is a standard winter variety in some sections. It is allied to the Large Late Drumhead, but is rather larger, and the foliage is of a deeper bluish-green.

NO. 4. *Berkshire Beauty*, Greg., '86; Till., '84.

As grown at the Station, this appeared to be a strain of Premium Flat Dutch;—a shade paler in color than that of the common strain, with the borders of the inner leaves rather less undulate, and the outer leaves more inclined to spoon-form. It is a little later than Fottler's Brunswick, and has proved very reliable for heading.

NO. 5. BRONSKI RUSSIAN, Ben., '86.

Syn. Ger. *Bronski, sehr fruhes spitzes russisches Kraut*, Ben., '86.

Closely resembles the Ulm Quintal; leaves small, oval or roundish, petioled; head round, extremely hard.

No. 6. BRUNSWICK SHORT STEM, Vil., '85.

Syn. *Bloomsdale Early Dwarf Flat Dutch?* Land., '84, '86; *Burpee's Short Stem Drumhead*, Burpee, '86; Large Brunswick Short-Stemmed, Vil.; Large Late Drumhead. (incorrectly) Veg. Gar., Vil.; *Short Stem Drumhead*, Brill, '86; Fr. *Chou de Brunswick pied court*, Vil., '85; Ch. tabouret, Vil.; Ger. Braunschweiger kurzbeiniger Kraut, A. de Cl.

Closely allied to Fottler's Brunswick, but differing from it in being even more dwarf and slightly smaller in size. The difference between the two is little marked, and may be due entirely to selection. Like the Fottler's Brunswick, it is very reliable for heading.

Correctly figured in the Vegetable Garden, p. 116; Les plantes potagères, p. 112.

No. 7. DANISH DRUMHEAD, Greg., '83, '85, '86.

Closely resembles the St. Denis, and has by some been thought identical with it.

Plant of medium size, rather spreading; foliage rather light bluish-green, quite glaucous; head large, much flattened, scarcely paler than the outer leaves but less glaucous, very compact; outer head leaves not meeting in fully developed heads; outer leaves compact, reflexed spoon-form, those immediately about the head distinctly recurving, border undulate, approaching ruffled; stem very short, the plant appearing to rest on the ground.

At the Station this has proved a very reliable intermediate cabbage. Correctly figured in Gregory's catalogue of 1886, and previous years.

No. 8. EARLIEST WHITE ERFURT, Till., '85.

Syn. Small Early Erfurt, A. de Cl.; Fr. Chou petit hâtif d'Erfurt, Vil. (d.); Ger. Erfurter kleines fruhestes festes niedriges Kraut, Vil.; Kleiner fruher weisser Erfurter Kopfkohl, A. de Cl.

Plant very small, compact, medium in color; head strongly flattened, rather large considering the small plant, moderately compact, pale green; outer leaves very few, inclining to horizontal, roundish, nearly flat, smooth, veins rather numerous and conspicuous; stem short.

A very early, and neatly headed variety; probably the earliest of the flat heading cabbages.

No. 9. EARLY BLEICHFELD, Greg., '85.

Syn. *Early Bleichfeld Giant*, Greg., '83, '86; Land., '86.

Resembles the Danish Drumhead in size, season, and habit, but differs from it in being of a deeper green, and decidedly less glaucous; head large, distinctly flattened, compact, of excellent quality ; outer leaves roundish or oval, usually distinctly reflexed, border strongly undulate, approaching ruffled ; stem very short.

This has proved a very reliable intermediate variety. It matures slightly earlier than Fottler's Brunswick.

Correctly figured in Gregory's catalogue of 1886 and previous years.

No. 10. *Early Deep Head*, Greg., '84, '85, '86.

A strain of Fottler's Brunswick having the head a little larger and rather less flattened, and the outer head leaves more overlapping. In season it is the same.

Correctly figured in Gregory's catalogue of 1886 and previous years.

No 11. *Early Drumhead*, Brill., '86; BURR.

Doubtfully distinct from the Early Summer, differing less from it than different plantings of the same differed from each other.

No. 12. EARLY FLAT DUTCH, HEN., '86; BRILL.

Syn. *Early Dwarf Flat Dutch*, Sib., '83.

Plant medium to rather small, rather low and spreading; foliage pale bluish-green, quite glaucous; leaves rather thick and stiff ; head medium to large, distinctly flattened, very compact and well defined ; the outer head leaves do not meet at the top, the outermost one shortly recurving; outer leaves small compared to the size of the head, roundish or oval, inclining to spoon-form, but often strongly reflexed, borders undulate or plain, lower leaves usually petioled ; stem very short.

A very excellent second early variety, of which several strains are extant. It matures about ten days later than Early Wakefield.

"A cross between the Oxheart and Large Flat Dutch. Plants usually grown in hot beds. If kept in cold frames over winter, they are very liable to go to seed, unless they are small and bedded late."—Francis Brill.

No. 13, *Early Summer*, Brill, '86 ; Hen., '86.

Syn. *Henderson's Early Summer*, Brill, '86; Ev., '86; Greg., '85, '86; VEG. GAR.; Hen., '86; Land., '85; Sib., '83, '86; Thor., '86 ; *Landreth's Early Summer Flat-Head?* Land., '84, '86; *Rawson's Early Summer*, Rawson, '86.

Scarcely if at all distinct from Early Flat Dutch. In our tests it has run rather more uniform than that variety, and the outer leaves are possibly a little less developed with the border rather less undulate.

This is a standard second early cabbage with very many market gardeners. It is very reliable for heading, while the small development of the outer leaves, and the compartively large size of the head, make it profitable for market culture. Like the Early Flat Dutch, it has some tendency to run to seed in plants wintered over in cold frames, unless sown quite late.

Introduced by Mr. Peter Henderson about 1875.

Figured fairly correctly in Vick's catalogue of 1885, and previous years.

No. 14. *Excelsior Flat Dutch.* Till., '85, 86.

Syn. *Excelsior?* '83; *Excelsior Late Flat Dutch*, Till., '84, '85; *Excelsior Large Late Flat Dutch*, Vick., '86; *Brill's Excelsior Flat Dutch*, Brill, '86; *Long Island Medium Flat Dutch*, Land., '84, '86.

A sub-variety of Premium Flat Dutch having lighter colored, bluish-green foliage, with less of the purple tinge late in the season, undulate rather than ruffled borders, and the surface of the leaves more nearly smooth. The stem is possibly a little shorter also, and the head rather more strongly flattened. In season, it is about the same as the Premium Flat Dutch, or possibly a little earlier.

In appearance this cabbage is rather intermediate between Premium Flat Dutch and Fottler's Brunswick. It differs from the latter in having a deeper bluish cast and in being more undulate on the borders.

"A very large and fine flat sort which my father grew more than 50 years ago—originally from Germany."—Brill.

At the Station this cabbage has proved very reliable for heading, and a desirable sort in all respects.

No. 15. FOTTLER'S BRUNSWICK, Brill, '86; Sib., '83; Till., '84.

Syn. *Bloomsdale Brunswick ?*, LAND., '84, '85, '86; *Fottler's Early Brunswick*, S. & F., '86; Till., '86; *Fottler's Early Drumhead*, GREG., Till., '84; *Fottler's Improxed Brunswick*, Ev., '86; Hen., '86; Sib., '86; Thor., '86; Vick, '86; *Fottler's Improved Early Brunswick*, Greg., '83; '85; '86.

Plant of large size, but very dwarf, appearing to set upon the ground; foliage rather pale, but distinctly bluish; head very large, perfectly defined, very strongly flattened, very compact, pale green, sometimes tinted with brown on the top; outer leaves numerous, rather large, roundish, disposed as in the Premium Flat Dutch, smooth or slightly blistered, border undulate or plain. It differs from the Premium Flat Dutch in being more dwarf, having a flatter head, less blistered leaves, with an undulate or plain instead of a ruffled border, besides being about a fortnight earlier in maturity.

First grown in this country by Mr. John Fottler, of Roxbury, Mass., about the year 1854, from a package of seed obtained near Erfurt, Prussia, bearing the name "*Früher Braunschweiger.*" Several attempts made later to secure more of the same stock of seed signally failed. The heads as first grown by Mr. Fottler were quite small, but by careful selection the size was much increased, while the earliness and short stems were preserved.

Introduced by Messrs. A. Schlegel & Co., of Boston, in 1866.

Correctly figured in "Cabbages and How to Grow Them," Greg., p. 50.

No. 16. Fumel, Veg. Gar.

Syn. Fr. *Femel*, Vil., '84, '85; Chou d'Aleth, Vil.; *Ch. de Fumel*, Vil., '84, '85; Ch. femelle, Vil.; Ger. Fumel niedriger oder femelle Kopfkohl, A. de Cl.

Rather intermediate between the smoothed leaved cabbages and the Savoys. Very vigorous, spreading rather than upright; foliage dark green, little glaucous, very coarsely blistered; lower leaves distinctly petioled; head of medium size, somewhat flattened, rarely solid, very pale, sometimes whitish-green; stem short; season second early. Differs from the Habas in being deeper green, and from the Dax, in having a shorter stem, and more spreading foliage. It has little to commend it for our climate, but is largely grown in central France.

Correctly figured in The Vegetable Garden, p. 117; Album des Clichés, Vil. No. 47378.

No. 17. Habas, Vil., '85.

Syn. Early Drumhead, Veg. Gar.; *Habas Drumhead*, Vil., '84; Habas Drumhead Early, A. de Cl.; Fr. *Chou de Habas*, Vil., '84, '85. Ger. Fruher Habas Kopfkohl, A. de Cl.

Resembles the Dax and Fumel in having coarsely blistered foliage, which allies it to the Savoys. Plant large and spreading, pale green, scarcely glaucous; head of medium size, distinctly flattened, rather compact, pale green; outer leaves numerous, roundish, often broader than long, nearly flat but often waved, borders undulate; leaves about the head nearly perpendicular, usually considerably taller than the top of the head; stem rather long.

Differs from the Dax and Fumel in having lighter colored, less glaucous foliage.

Correctly figured in The Vegetable Garden, p. 117; Les plantes potagères, p. 113.

No. 18. Large Late Drumhead; Burr; Greg.; Hen., '86; Land., '86; Sib., '83, '86; Thor., '86.

Syn. American Drumhead, Burr; Brill; *Bridgeport Late Drumhead?* Greg., '86; *Buist's Late Drumhead Improved?* Buist, '86; *Improved Drumhead*, Brill, '86; *Landreth's Large Late Mountain?* Land., '84, '86; *Late American Drumhead*, Till., '84, '85; *Late Mountain?* Thor., '86.

Plant very large, rather low and spreading, foliage deep bluish green, strongly blistered, borders ruffled; head large, flattened or nearly round, compact, rather pale green, often tinted a little with brown on the top; outer leaves numerous, large, roundish; stem short.

This variety is very hardy, seldom fails to form a head, keeps well and is of good quality. It is recommended as the best variety for feeding stock.

No. 19. LARGE WHITE BRUNSWICK, Dam., '86.

Syn. *Large White Solid Magdeburg*, Ben.,, '86; Fr. *Chou pomme blanc gros plat de Magdebourg*, Dam., '86; Ger. *Magdeburger, grosstes weisser plattes Kopfkohl*, Dam., '86.

Plant of medium size, resembling the Early Summer rather closely, except that the head is less strongly flattened; head very pale, sometimes whitish-green. About the same in season as Fottler's Brunswick.

No. 20. *Louisville Drumhead*, Brill., '86.

Syn. *Louisville Early Drumhead*, D. of A., '86.

Resembles closely Fottler's Brunswick, but matures ten to fourteen days earlier. At the Station this proved a very fine heading cabbage. The heads were very well defined and neatly formed.

"The finest strain of Drumhead I have ever seen."—Francis Brill.

No. 21. *Low's Early Peerless*, Greg., '85, '86; Till., '84.

Syn. *New Peerless Early*, Burpee, '86.

Scarcely distinct from Early Summer—by some considered the same. In our plantings the heads appeared slightly larger, and the foliage slightly more bluish.

Said to be a cross between Fottler's Brunswick and Early Wakefield.

No. 22. MARBLED BURGUNDY, Vil., '84, '85.

Syn. Marbled Bourgogne, GREG.; Marbled Burgundy Drumhead, VEG. GAR.; Fr. Chou cabus blanc à côtes bleues, Vil.; Ch. de champ d'or, Vil.; Ch. de Constance, Vil.; Ch. cristallin, or cristollat, Vil.; Ch. *Marbre de Bourgogne*, Vil., '84, '85; Ch. Marbré de Saint Claude, Vil.; Ger. Rothmarmorirter Burgunder Kopfkohl, A. de Cl.

Plant of medium size, rather light green, with the midribs and larger veins tinted with purple; head more or less flattened, very solid, scarcely paler than the outer leaves, tinted with purple on the top; outer head leaves usually short, not meeting at the top, often leaving a slight hollow in the head; outer leaves numerous, inclining to horizontal, roundish, nearly flat, but inclining to spoon-form, border plain, usually slightly reflexed, surface smooth.

Correctly figured in The Vegetable Garden, p. 121; Les plantes potagères, p. 118.

In habit this cabbage resembles some of the red varieties. It is very hardy, and is much grown in eastern France and Switzerland, but has little merit in our climate.

No. 23. MARBLEHEAD MAMMOTH, Greg., '85; Sib., '83, '86.

Syn. *Marblehead Mammoth Drumhead*, BURR., GREG., ; '86.

Plant of very large size, rather low and spreading, rather pale green, not very glaucous; head more or less strongly flattened, compact, scarcely paler than the outer leaves; the latter are not very numerous, very large, inclining to horizontal, roundish, often waved, rather inclining to spoon-form, but often much reflexed, border coarsely undulate or plain, surface smooth, or with a few coarse blisters, veins numerous, but not very conspicuous; stem short; quality remarkably sweet and tender.

This is considered to be the largest of the heading cabbages, and in very high culture the plants are said to have attained an average weight of 30 pounds, with a maximum of 90 pounds. It originated with Mr. Alley, of Marblehead, Mass., probably from the Mason, having been developed by years of careful selection. It was introduced by Mr. Gregory about the year 1865.

The peculiarity of this cabbage is that it responds liberally to the very highest culture, and it is only under these conditions that it attains its extraordinary size and weight. Grown under average conditions, it is less reliable than Fottler's Brunswick or Premium Flat Dutch. For a maximum growth, the plants should not be set nearer than four feet apart each way.

No. 24. NEWARK EARLY FLAT DUTCH, Brill, '86; Greg., '85, '86.

A strain of Early Flat Dutch much grown by market gardeners about New York city. The only distinguishing points between the two, in our plantings, appeared to be that the Newark strain had the outer leaves slightly less developed and their borders a little more undulate. In season they have averaged about the same.

"The result of an intentional cross between the old French Oxheart and Large Flat Dutch, made by my father, for the purpose of securing a second early sort of good size." —Francis Brill.

NOTE. Since the above was written, I have learned from Mr. Brill that the Newark Early Flat Dutch and Early Flat Dutch are to be considered identical and that the difference between these and the Early Summer, if any, is extremely slight.

No. 25. Premium Flat Dutch, Burr.; Hen., '86; Brill., '86; Ferry, '86; Greg., '85, '86; Maule, '86; Till., '86; Vick, '86.

Syn. *Bristol Flat Dutch?* Brill., '86; *Bloomsdale Large Late Flat Dutch*, Land., '84, '86; Bloomsdale Late Flat Dutch, Land. (d.); *Buist's Late Flat Dutch*, Buist, '86; *Burpee's Superior Large Flat Dutch*, Burpee, '86; *Everitt's Mammoth Large Late Flat Dutch*, Ev.,'86; *Fine Large Flat Dutch*, Thor., '86; *Henderson's Selected Late Flat Dutch*, Hen., '86; *Large Flat Dutch*, Vick,'86; *Large Late Flat Dutch*, Till., 86; *Late Flat Dutch*, Hen., '83; Vil., '84, '85; Late Flat Dutch Drumhead? A. de Cl.; *Marblehead Dutch?* Greg., '86; *Sibley's Premium Large Late Flat Dutch*, Sib., '83, '86; Fr. *Chou de Hollande tardif?* Vil. '84, '85; Chou cabus blanc de montagne? Vil.; Ger. Grosses spates hollandisches Kraut? Vil.; Hollandischer grosses spater Kopfkohl? A. de Cl.

Plant of very large size, rather low and spreading; foliage deep bluish-green, the bluish cast distinct and rather conspicuous; late in the season the edges of some of the outer leaves and the top of the head often assume a purple tint; head very large, very well defined, distinctly flattened, less strongly flattened than Fottler's Brunswick, but more so than Late Drumhead, very compact, pale green; when it is fully developed the outer head leaves do not meet at the top, but roll back a little at the apex, exposing the leaves below through a triangular opening; exterior leaves numerous, large, the outer ones lying nearly flat upon the ground, those about the head perpendicular, spoon-form, borders reflexed a little, surface slightly blistered or smooth, intermediate leaves nearly flat, border distinctly ruffled; stem quite short.

"One of the largest of the cabbages, rather late, good for autumn use, and one of the best for late keeping, retaining its flavor till late in spring. The head is white, crisp, tender and well flavored. It is very reliable for heading, and for the market has no superior."—Burr.

No. 26. Quintal—Veg. Gar.

Syn. Drumhead Quintal, A. de Cl.; *Early Dwarf Dutch* ? Sib. '86; Hundredweight, Veg. Gar.; Hundredweight Drumhead, Vil.; Mason's Drumhead, Veg. Gar.; Vil.; *Quintal Drumhead*, Fer., '86; Sib., '86; Vil., '85; *Stone Mason Drumhead* (incorrectly), Sib., '86; Fr. Chou cabus à pied court de Saint Flower, Vil.; Ch. d'Alsace, Vil.; Ch. de Strasbourg, Vil.; *Ch. Quintal*, Vil., '85; Ch. Quintal gros d'Allemande, A. de Cl.; Gros Chou d'Allemande, Vil.; Ger. Centner Kraut, Vil.; Strassburger Centner Kraut, Vil.; Strassburger Centner Kopfkohl, sehr grosser, A. de Cl.; Holl. Straatsburger kool, Vil.; Ital. Cavolo cappuccio grosso di Germania, Vil.; Port. Couve branco d'Alsacia, Vil.

Plant large, but low, rather spreading, distinct through its very numerous white veins; foliage rather light green, little glaucous; head large, much flattened, scarcely paler than the outer leaves; outer head leaves usually overlapping; outer leaves few, starting horizontal, but curving rather abruptly upward, oval, usually strongly spoon-form, often reflexed, border undulate or ruffled, surface smooth; stem very short.

"One of the oldest and best of the late cabbages; probably no other heading cabbage occupies so important a place in field culture."—Vil. At the Station this cabbage has proved among the most reliable for heading.

Correctly figured in The Vegetable Garden, p. 118; Les plantes potagères, p. 114.

NO. 27. RUSSIAN FLAT GIANT—Ben., '86.

A large, loose and spreading, pale green cabbage, peculiar from its outer leaves growing almost straight outward from the stem, at an angle of about 45 degrees; head strongly flattened, scarcely paler than the outer leaves, moderately compact, outer leaves oval, narrowing to the base, surface slightly blistered, border nearly plain; lower leaves petioled; stem rather tall.

NO. 28. SCHWEINFURT, VEG. GAR.; Vil., '85.

Syn. *Large Early Schweinfurt*, Hen., '86; *Round Schweinfurt*, Land., '86; *Early Schweinfurt*, GREG.; Sib., '86; *Schweinfurs Largest White*, Ben., '83; *Schweinfurth*, Sib., '83; *Schweinfurth Quintal*, Vil., '84; *Schweinfurt Quintal*, Greg., '83, '85, '86; Schweinfurt Quintal Drumhead, A. de Cl.; Fr. *Chou de Schweinfurt*, VIL., '84, '85; Ch. de Schweinfurth, A. de Cl.; Ger. Schweinfurter grosses Kraut, Vil.; Schweinfurter sehr grosser fruher Kopfkohl, A. de Cl.

Plant remarkably vigorous, growing to an immense size, often three feet or more in diameter, dull, dark, slightly bluish-green, considerably glaucous; head very large, but never solid; very pale green, rather strongly flattened; outer head leaves overlapping, but not always closely, apex often slightly recurved; outer leaves extremely large, roundish, inclining to horizontal, nearly flat, borders often reflexed, strongly undulate, margin more or less sinuate.

This cabbage is superior for family use, being extremely tender and crisp. The heads though rather loose are compact in appearance, but too brittle to bear transportation. It is said not to bear the heat well. In season it is second early, or about the same as the Winnigstadt. At the Station it has proved very reliable for heading.

The cut of this cabbage given in The Vegetable Garden and Les plantes potagères shows the foliage more strongly blistered, and the borders more ruffled than they have ever appeared in our plantings. The large cut in Album des Clichés, No. 47,380 is, however, an exact representation of it.

No. 29. *Silver Leaf Drumhead*—Brill.,'86; Hen., '86; Thor., '83, '86.

A strain of the Large Late Drumhead, slightly paler in color; head rather strongly flattened; and much washed with purple on the top. It has proved very reliable for heading.

No. 30. ST. DENIS DRUMHEAD—VEG. GAR., Vil., '85.

Syn. *Bloomsdale Early Drumhead?* Land., '86; *Early Drumhead* (incorrectly), Land., '86; *Early Flat Dutch* (incorrectly), Land., '86; *St. Denis Drumhead*, Greg., '82; *St. Denis Large Drumhead*, Vil., '84; *St. Denis Large Early Drumhead*, Land., '86; Fr. *Chou de St. Denis*, VIL., '84, '85; Ch. d'Aubervilliers, Vil.; Ch. cabus gros de Laon, Vil.; Ch. des Vertus; Ger. Angelberger mittelfruhes Kraut; Griechisches Centner Kr., Vil.; Saint Denis grosser Kopfkohl, A. de Cl.

Plant of rather large size, rather low and spreading, dark, distinctly bluish-green, with a slight lustre; head medium or large, distinctly flattened, pale green, occasionally tinted with dark brown at the top, very compact; outer head leaves distinctly recurved at the top of the head; outer leaves numerous, roundish, flat or spoon-form, sometimes reflexed, borders undulate, surface slightly blistered, stem medium or short, the lower leaves seeming to start at the surface of the ground.

This cabbage appears to be somewhat allied to the Premium Flat Dutch. The leaves are stiffer and less reflexed, the color slightly deeper-bluish green, and the surface has a little more lustre. The plants are more uniform than in that variety.

Correctly figured in the Vegetable Garden, p. 114; Les plantes potagères, p. 110.

Largely grown for the Paris market, but comparatively little known in this country.

No. 31. STONE MASON;—GREG., '85, '86; Hen., '86.

This cabbage, as grown at the Station, has seemed very poorly fixed, and has borne considerable resemblance to the Premium Flat Dutch. I quote Mr. Gregory's description: "An improvement on the Mason, which was selected by Mr. John Mason, of Marblehead, from a number of varieties of cabbage that came from a lot of seed purchased and planted as Savoys.

"Mr. John Stone afterwards improved upon the Mason, by increasing the size of the heads. Different growers differ in their standard of a Stone Mason cabbage in earliness and lateness, in the size, form and hardness of the head, but all these varieties agree in the characteristics of being very reliable for heading, in having heads which are large, very hard, very tender, rich and sweet; short stumps and few waste leaves. The color of the leaves varies from a bluish-green to a pea-green, and the structure from nearly smooth to much blistered. In their coloring and blistering some specimens have almost a Savoy cast.

"It is the standard drumhead cabbage in the markets of Boston and other Northern cities." "Cabbages and How to Grow them," p. 47.

No. 32. *Surehead*;—Ev., '86.

Syn. *All Head*, Ev., '86; *Burpee's Surehead*, Brill, '86, Burpee, '86; *Maules' Surehead*, Maule, '86.

Closely resembles the Bergen Drumhead if not identical with it. The difference, if any, between the two as grown at the Station, is too slight to admit of description.

No. 33. ULM QUINTAL—Ben., '85.

Syn. Fr. *Chou pomme blanc Quintal d' Ulm*, Ben., '86; Ger. *Ulmer grosses spates Centner-Kraut*, Ben., '86.

Plant of medium size, peculiar in habit, having small outer leaves, of which the lower ones are long petioled, giving the foliage a loose and open appearance; leaves dark bluish-green, the color of the St. Denis, but with less lustre; head distinctly flattened, pale green, almost always tinted with purple on the top, very compact, the outer head leaves not meeting; outer leaves small, oval or spatulate, inclining to spoon-form, smooth, border plain.

This cabbage might be called intermediate between the green and red cabbages, as its head inclines to red, and has the extreme hardness of the red cabbages.

No. 34. VAUGIRARD;—BURR, VEG. GAR, Vil., '84, '85.

Syn. Vaugirard Winter, A. de Cl.; Vaugirard Winter Drumhead, Vil., '84,; Fr. *Chou de Vaugirard*, VIL., '84, '85; Ch. d' hiver, Vil.; Ger. Grosser Vaugirard Winter Kopfkohl, A. de Cl.

A rather coarse French variety of medium size; foliage deep, slightly bluish-green, borders of outer leaves often tinted with purplish-red; head slightly flattened, compact, pale green, faintly tinged with red on the top; outer leaves roundish or oval, spoon-form, smooth, borders rather strongly undulate, veins numerous, rather conspicuous.

A very hardy variety, much grown about Paris for winter consumption, the plants remaining in the open ground until wanted for use or market.

Figured fairly correctly in The Vegetable Garden, p. 119; Les plantes potagères, p. 116.

No. 35. *Vilmorin's Early Flat Dutch*—Greg., '83, '85, '86.

A French strain of the Early Flat Dutch, differing from it in having the head less flattened, rather more compact, the plant very slightly smaller, the borders of the leaves ruffled or strongly undulate, and, judging from our plantings, maturing slightly later.

No. 36. *Warren*—Greg., '85, '86.

Syn. Warren's Stone Mason, (d) Breck's Cat., '86.

Described as a strain of Stone Mason. At the Station it has run much more uniform than that variety, paler green, with a more nearly plain border, and has closely resembled Early Deep Head. It has proved very reliable.
Correctly figured in Gregory's catalogue of 1886, and previous years.

II. Heads round or nearly so.

**Foliage green.*

No. 37. CANNON BALL—GREG., '83, '85, '86.

Plant of medium size, low, and rather spreading; foliage dark dull green, slightly glaucous; head globular, or very slightly flattened, pale green, sometimes slightly tinted with red on the top, very compact; outer head leaves usually over-lapping; outer leaves few, roundish, usually distinctly spoon-form, smooth, or slightly blistered, border strongly undulate; stem very short.
In season, about a week later than Early York.

This has proved very reliable for heading at the Station. "In hardness and relative weight, it is not excelled if equaled by any other cabbage. It delights in the highest cultivation possible."
"Cabbages and How to Grow Them."—Greg., p. 51.

No. 38. DAX—Vil., '84, '85.

Syn. Dax Drumhead, VEG. GAR.; Dax Very Large Late, Vil.; Fr. *Chou de Dax*, VIL., '84, '85; Ger. Spater Dax Kopfkohl, A. de Cl.

A very large growing, loose heading, rather long stemmed, blistered leaved cabbage, allied to the Savoys. It resembles the Habas, but has deeper green, and more glaucous foliage, and the head is round instead of being flattened. It has no value in this climate unless it be for forage.
Correctly figured in The Vegetable Garden, p. 117; Les plantes potagères, p. 113.

No. 39. *Early Dutch Drumhead*—Veg. Gar.; Vil., '85.

Syn. *Drumhead Early Dutch*, Vil. '84; Early Low Dutch, Burr; Fr. *Chou de Hollande pied court*, Vil. '84, '85; Ger. Bleichfelder kraut, Vil.; Hollandisches neidriges Kopfkohl, A. de Cl.; Hollandischer neidriger plattes Kr., Vil.

A somewhat later sub-variety of the St. John's Day Late. Head very well defined, almost round, usually a little flattened, extremely compact, a shade paler than the outer leaves, which are rather few in number, dark green, slightly glaucous, oval or roundish, and loosely disposed. They incline to spoon-form, and are often rather sharply folded on the midrib. The head is sometimes slightly tinted with brown on the top.

Correctly figured in The Vegetable Garden, p. 115; Les plantes potagères, p. 111.

No. 40. Green Glazed—Burr; Gregg., '85, '86; Hen., '86; Land., '86; Sib., '86; Thor., '86; White.

Syn. American Green Glazed, Greg.; *Green Glazed American*, Veg. Gar.; Vil., '84, '85; Fr. *Chou vert d'Amerique*, Vil., '84, '85; Ger. Grunglaisirter Americanischer Winter Kopfkohl, A. de Cl.

Plant very large, with numerous very firm and stiff, spreading outer leaves, of a very distinct deep glossy green, nearly or quite without bloom; head large, but loose, roundish; outer leaves roundish, slightly blistered, with undulate borders; stem rather long.

Of no value in the Northern States, as it is so late as seldom to form a head. It is grown to some extent in the South, where it is thought to be less liable to injury from the cabbage worm than other varieties.

In our plantings, this cabbage has been more mixed than any other variety tested, little difference appearing in this respect in the plants from the seed of different seedsmen.

Correctly figured in The Vegetable Garden, p. 119; Les plantes potagères, p. 116.

No. 41. Russian Round Giant,—Ben., '86.

Plant extremely large, spreading, loose and open; foliage rather pale, but distinctly bluish-green; head nearly or quite round, very compact, pale green; outer leaves very large and numerous, extending nearly straight from the stem, at an angle of about 45 degrees, roundish or oval, slightly spoon-form or nearly flat, much blistered, border plain or slightly undulate. Stem of moderate height.

No. 42. St. John's Day Early,—Sib., '85; Vil., '86.

Syn. *Early Drumhead* (incorrectly), Sib., '86; *Early St. John's Day*, Sib., 83; *Early St. John's Day Drumhead*, Hen., '86; St. John's Day Dwarf, Vil.;

St. John's Day Dwarf Drumhead, VEG. GAR.; *St. John's Day Early*, Sib., '85.; Vil., '85 *St. John's Day Early Drumhead*, Vil., '84; Fr. Chou Colas, Vil.; Ch. de Chenillet, Vil.; Ch. de Genillé, Vil.; *Ch. Joanet hatif*, VIL., '84, '85; Ch. Jaunet, Vil.; Ch. nantaise, Vil.; Ch. pommé d'Angers, Vil.; Ger. Fruher Johannistag Kopfkohl, A. de Cl.

Distinct through its short stem and neatly formed head. Plant rather small, foliage deep green, slightly glaucous; head roundish or slightly flattened, very compact, pale green; outer leaves few and small, roundish or oval, often truncated or emarginate at apex, distinctly spoon-form or flat, smooth, with the border coarsely undulate or nearly plain; veins rather conspicuous; stem very short.

Figured correctly in The Vegetable Garden, p. 113; Les plantes potagères, p. 109.

No. 43. ST. JOHN'S DAY LATE—Vil., '85.

Syn. *Large Late Drumhead* (incorrectly), Sib., '86; Late St. John's Day, VEG. GAR.; St. John's Day Large Drumhead, Vil.; St. John's Day Late, A. de Cl.; *St. John's Day Late Drumhead*, Vil., '84; Fr. Chou capuch, Vil.; *Ch. Joanet Gros*, VIL., '84, '85; Chou Joanet gros tardif, A. de Cl.; Ch. Joanet tardif, Vil.; Ger. Grosser Johannistag Kopfkohl, A. de Cl.

Plant resembling in habit the St. John's Day Early, but considerably larger in size; foliage deep green, slightly glaucous, leaves rather thick and stiff; head roundish or slightly flattened, very compact, rather pale green; outer leaves not very numerous, closely set, about half erect, usually rather strongly recurved, roundish, inclining to spoon-form, border plain, or slightly undulate, surface nearly smooth.

This cabbage is rather intermediate in habit between the Oxhearts and Early Summer. It differs from the former in having a round or flattened head, and more roundish leaves, and from the latter in its upright habit, darker and less glaucous foliage, and thicker head.

Correctly figured in The Vegetable Garden, p. 115; Les plantes potagères, p. 111.

†*Foliage distinctly washed with red or purple.*

No. 44. *Berlin Large Dark Red*—H. & S., '86.

Appears to be an earlier form of Red Dutch.

No. 45. EARLY DARK RED ERFURT—Greg., '85, VEG. GAR.; Vil., '84, '85.

Syn. *Earliest Blood Red Erfurt?* Greg., '86; Sib., '83, '85; Early Blood Red, BURR (d); *Early Blood Red Erfurt*, Greg., '86; Hen., '86; Early Dwarf Red, Burr (d); Small Red, Burr (d); Fr. *Chou rouge fonce hatif d'Erfurt*, VIL., '84, '85; Ger. Erfurter blutrothes fruhes Salat-Kraut, Vil.; Schwarzrother Erfurter Kopfkohl, A. de Cl.

Plant small, compact, spreading, rather than upright, foliage a pale green ground, more or less shaded with purple, with deep purple veins and ribs, head roundish, extremely solid, rich deep, glossy purplish-red on the outside, inside it is less deeply colored than the outside would indicate ; outer leaves few, small, roundish, smooth, border slightly undulate ; stem very short.

The earliest of the red cabbages and one of the earliest of cabbages.

Correctly figured in The Vegetable Garden, p. 120 ; Les plantes potagères, p. 117.

No. 46. *Garfield Pickling*—Greg., '84, '85, '86.

Syn. *New Garfield Pickler*, Till., '84.

Appears to be a larger, taller and later sub-variety of the Early Dark Red Erfurt.

No. 47. *Red Drumhead*—Greg., '83, '85, '86.

Syn. *Dark Red Drumhead*, Vil., '85; Large Blood Red, Vil. ; *Large Red Drumhead*, Vil., '84; Large Red Dutch, Burr; Large Red Dutch Pickling, Veg. Gar. ; *Mammoth Rock Red*, Hen., '86; *Padilla Purple Pickling?* Till.,'85; Vil. ; Pickling, Vil. ; *Red*, Thor., '86; *Chou rouge gros*, Vil., '84, '85: Ger. Blutrothes grosses spates Kraut, Vil. ; Rother grosser Kopfkohl, A. de Cl. ; Holl. Groote late roode kool, Vil. ; Port. Couve vermelho grande, Vil.

A large sub-variety of the Red Dutch, with the head round, or nearly so, somewhat harder, and of nearly double the size. The leaves have the border much undulate, or ruffled, and the lower ones are often petioled. Like the Red Dutch, it is a very late variety.

"Care should be taken not to run these cabbages too large, or they will lose in color, which lessens their value for pickling and salad uses. Attempts at growing seed from this cabbage in this country have generally been quite unsuccessful." "Cabbages and How to Grow Them ;" Greg, p. 42.

Correctly figured in The Vegetable Garden, p. 120; Les plantes potagères, p. 117.

The Red Dutch and Red Drumhead appear to be much confused by seedsmen. In many of our plantings the two appeared to be mixed, and it is probable that each is often sold for the other.

No. 48. Red Dutch—Brill; Ev., '86; Greg., '85, '86; Hen. ; Land., '86.

Syn. *Dark Red Dutch* Vil., '84; *Early Dark Red Dutch*, Vil., '85; *Fine Red Dutch*, Sib., '86; *Red Dutch Pickling*, Hen., '86; *Red for Pickling*, Thor., '83; *Red Pickling*, Sib., '86; Utrecht Red, Burr, Veg. Gar., Vil. ; Fr. Chou, noiratre, Vil. ; *Ch. rouge petit*, Vil., '84, '85; Ch. rouge petit d' Utrecht

Vil., Ger. Utrechter kleines Schwarzrothes Kraut, Vil.; Holl. Kleine zwarte utrechtische roode kool, Vil.; Port. Couve vermelho escuro pequeno d' Utrecht, Vil.

Plant of medium size, compact, greenish-purple, often with a peculiar metallic lustre, with purple ribs and veins; head roundish, or slightly oblong, rich dark purple, but with less lustre than in the Early Dark Red Erfurt, not very strongly colored inside; extremely compact; outer leaves rather numerous, roundish, inclining to spoon-form, sometimes waved, smooth, border plain or slightly undulate; stem of medium length.

"This cabbage is usually planted too late. It requires the whole season to mature. It is used for pickling, or cut up fine as a salad, served with vinegar and pepper. This is a very tender cabbage, and were it not for its color, would be an excellent sort to boil." "Cabbages and How to Grow Them;" Greg., p. 42.

III. **Head egg-shaped, the smaller end downward.**

No. 49. SUGAR LOAF--VEG. GAR.; Vil., '84, '85; Greg., '85, '86.

Syn. *Early Sugar Loaf*, GREG.; Sib., '83, '86; LAND., '86. Fr. *Chou pain de sucre*, VIL., '84, '85; Ger. Zuckerhaut Kraut, Vil.; Zuckerhaut fruher Kopfkohl, A. de Cl.: Holl. Vroege suikerbroad kool, Vil.

Distinct; plant rather small, inclining to upright, resembling the Early York but larger, and taller; foliage dull, green, little glaucous, head long egg-shaped at least twice as long as thick, the small end downward, pale green, moderately compact; outer head leaves distinctly hood-shaped, clasping the head, closely reminding one of a head of Cos lettuce; sometimes recurving a little at the apex, outer leaves oval, those surrounding the head deeply spoon-form, the plain border often reflexed in the lower leaves, margin entire, midribs and veins not very conspicuous.

An old variety of medium season and excellent quality, but is said not to endure the heat well. It was offered by Thorburn in 1828.

Correctly figured in The Vegetable Garden, p. 110; Les plantes potagères, p. 105.

IV. **Heads elliptical.**

No. 50. EARLY YORK, BRILL; Ferry '83, GREG., '85, '86; Hen., '86; BURR; Sib., '86; Thor., '86; WHITE; Vil., '84, '85.

Syn. *Early Dwarf York*, VEG. GAR.; Vil., Sib., '86; Early May, Vil.; *Early York Dwarf*, Sib., '83; *Early York English*, Land., '86; English Early York, Land., (d.); Fr. *Chou d' York petit hatif*, VIL., '85; Ger. York'sches allerfruhestes weisses Kraut, Vil., Fruher Zucker Maispitzkohl, Vil.; Yorker fruher Zwerg Kopfkohl, A. de Cl.

Plant small in size; leaves deep, slightly bluish-green, not much glaucous; head small, oval, or inversely conical, nearly twice as long as thick; rather solid, deep green; outer head leaves distinctly hood-shaped; outer leaves few in number, inclining to upright, obovate, often reflexed and frequently waved in a peculiar manner, the midrib curving first upward, then downward, and upward again at the apex, leaves sometimes much twisted and distorted, margin and apex usually entire, and border plain; stem usually quite short, sometimes nearly as long as the head.

An old and very popular early variety, said to have been introduced from Flanders into Yorkshire, Eng., (whence its name) more than a century ago. Owing to its small size and reliability for heading, it was for many years the most popular early cabbage with market gardeners, but has been largely superseded by more modern varieties.

Figured correctly in the Vegetable Garden, p. 109; Les plantes potagères, p. 104.

No. 51. LARGE YORK;—BURR; GREG., '86; HEN.; VEG. GAR.; Vil., '84, '85.

Syn *Landreth's Large York*, Land., '85; *Large Early York*, BRILL, WHITE, Sib., '83; Fr. *Chou d'York gros*, VIL., '84, '85; Ger. Yorker grosser Kopfkohl, A. de Cl.; York'sches grosser Kraut, Vil.

The general characters are the same as in the Early York; but the plant is somewhat larger in all its parts, and the head is a little thicker in proportion to its length, rather more compact, and forms on the average about two weeks later. It is claimed that the plants endure the heat of the sun in warm climates better than those of the Early York.

Figured correctly in the Vegetable Garden, p. 109; Les plantes potagères, p. 104.

V. Heads more or less distinctly conical.

*Foliage Green.

No. 52. *Bacalan Late,*—Vil., '84, '85.

Syn. Bacalan Large, Vil., Large Bacalan, VEG. GAR.; Fr. *Chou Bacalan gros*, VIL., '84, '85; Ch. Bacalan tardif, Vil.; Ger. Grosser Bacalauer Kraut, Vil.

A sub-variety of the Early Bacalan of slightly larger size, and with the head a little more pointed and more compact. It holds the head better than the Early Bacalan, but it is scarcely later in maturing.

Correctly figured in the Vegetable Garden, p 113; Les plantes potagères, p. 108.

No. 53. *Bloomsdale Early Market,*—VIL.; LAND., '84, '86.

A very poorly fixed sub-variety of the Winnigstadt or Bacalan Late.

No. 54. EARLIEST DWARF CONICAL GERMAN,—H. & S. '86.

Of medium size, resembles the Large Bacalan, but of a pale bluish-green color, strongly glaucous ; not well fixed ; some heads more approached the Winnigstadt.

No. 55. EARLY BACALAN—VEG. GAR., Vil., '85.

Syn. *Bacalan Early*, Vil., '84; Fr. *Chou Bacalan hatif*, VIL., '84, '85; Ch. de Saint Brieuc, Vil.; Ch. d'Angerville, Vil.; Ch. pommé de Craon, Vil.; Ger. Fruhes Bacalaner Kraut, Vil.

Plant resembles in general appearance the Winnigstadt, but differs from it in having a less bluish cast, a rather shorter, less distinctly pointed and less compact head. Plant of medium size, upright rather than spreading, medium or rather deep green, slightly glaucous ; head of medium size, Oxheart shape, but rather taller than that of the Large Oxheart, clear or pale green, compact; outer head leaves scarcely meeting on fully developed heads ; outer leaves roundish, nearly flat or inclining to spoon-form, borders distinctly ruffled, surface smooth.

Larger than the Oxheart, but not less early. It is especially adapted to the mild maratime climates of the west of France, where it is largely cultivated. It came originally from Saint Brieuc.—Vil.

Correctly figured in The Vegetable Garden, p. 112 ; Les plantes potagères, p. 108.

No. 56. EARLY OXHEART—BRILL.; GREG.,'86; HEN.; VEG. GAR.; Vil., '84, '85.

Syn. *Early French Oxheart*, Hen., '86; Sib., '86; Oxheart Early, A. de Cl.; *Oxheart French*, Land., '86; Small Oxheart, BURR (d); Fr. *Chou cœur de bœuf petit*, VIL., '84, '85; Ger. fruhes kleines Ochsenherz Kraut, Vil.; Kleiner Ochsenherz Kopfkohl, A. de Cl.

The plant rather closely resembles that of Early Wakefield, the chief difference in the appearance being that the outer leaves are not quite so roundish, being more inclined to spatulate, grow rather more upright, and are usually either more or less spoon-form or revolute, being rarely flat. They are sometimes much twisted or distorted. The head is of about the same size, shape and texture, but matures on the average about ten days later ; stem short.

Correctly figured in The Vegetable Garden, p. 110 ; Album de Clichés, No. 47,362.

No. 57. *Early Paris*—Greg., '84, '85, '86.

Syn. *Early Paris Market*, Vil., '85; Paris Market Very Early, A. de Cl.; Very Early Paris Market, VEG. GAR.; Fr. *Chou cœur de bœuf Moyen de la halle*, Vil., '85; Ger. Fruhes Pariser Markt Kopfkohl, A. de Cl.

A sub-variety of the Etampes, having the leaves more strongly waved, growing slightly more upright, and with the borders undulate or ruffled. In season it is a few days later than the Etampes.

Correctly figured in The Vegetable Garden, p. 111; Album des Clichés, Vil., No. 47,346.

No. 58. Early Wakefield—Greg., '83, '85, '86; Burr.

Syn. *Early Jersey Wakefield*, Burpee, '86, Ev., '86, Fer., '86, Hen., '86, Howcroft, '85, Sib., '86, Till., '86, Thor., '86; Jersey Wakefield, Hen., (d) Veg. Gar.; *Select Very Early Jersey Wakefield*, Land., '86; *True Early Jersey Wakefield*, Brill, '86; Till., '86; *Henderson's Selected Early Jersey Wakefield*, Hen., '86; Fr. Chou de Wakefield, Vil., (d).

Plant medium in size, dull, dark green, little glaucous; leaves round, very thick and stiff; head ox-heart shape, i. e. a short cone, inflated, with a rounded apex; distinctly paler than the outer leaves, compact; leaves about the head nearly erect; outer leaves usually nearly flat, smooth, with plain borders and entire margins; stem short.

A very popular variety with market gardeners, for earliest crop. Said to have been first grown by Francis Brill, at Jersey City, N. J., about 1830, from seed imported from England. Its merit consists in its large, compact head, reliability for crop and great earliness. It is said to produce little seed, and only that grown in this country has proved reliable.

Correctly figured in Gregory's catalogue of 1881 and later years.

No. 59. *Enfield Market*—Greg., '85.

Syn. Blenheim, Vil.; King of the Cabbages, Vil.; Vanack, Vil.; Chou de Battersea, Vil.

Closely allied to the Large Oxheart, of which it is but a sub-variety. One of the cabbages most extensively grown for the London market.

No. 60. Etampes—Thor., '86.

Syn. *Burpee's Early Advance*, Burpee. '86; *Early Etampes*, Brill, '86, Ev., '86, Sib., '86, Veg. Gar.; *Henderson's Premier*, Hen., '84, '86; *Johnson and Stokes' Earliest*, J. & S., '86; *Landreth's Earliest*, Land., '84, '85; *Very Early Etampes*, Greg., '86, Vil., '84, '85; Fr. *Chou tres hatif d'Etampes*, Vil., '84, '85; Ger. Sehr fruher Etampes Kopfkohl, A. de Cl.

Closely resembles Early Wakefield, the chief difference being that the plant is a trifle smaller, the head usually not quite so solid, especially at the tip, and matures on the average very slightly earlier, and the outer leaves are thinner, and hence more waved and distorted.

It was obtained by M. Bonnemain, Secretary of the Horticultural Society of Etampes (France), Vil. The only advantages it is claimed to possess over the Early Wakefield are the slightly smaller size of the plant, and its superior earliness. The latter quality is not always maintained and it is said to be inferior to the Early Wakefield in shipping qualities.

Correctly figured in The Vegetable Garden, p. 110; and fairly so in Les plantes potagères, p. 106.

No. 61. *Large Jersey Wakefield*—Land. '86.

Syn. *Large Early Jersey Wakefield*, Brill, '86.

A selection of the Early Wakefield made by Mr. Francis Brill, of Riverhead, L. I. The heads are nearly double the size of those of Early Wakefield and resemble them in shape, but with us were decidedly less uniform. In season, some heads were almost as early as the Early Wakefield, while others were much later.

No. 62. LARGE OXHEART—BURR; Greg., '85, '86; Vil., 84, '85.

Syn. French Oxheart, VEG. GAR.; Large French Oxheart, Burr, Vil.; Oxheart Large, A. de Cl.; Fr. *Chou cœur de bœuf gros*, VIL., '84, '85; Ger. Fruhes grooses Ochsenherz Kraut, Vil; grosser Ochsenherz Kopfkohl, A. de Cl.

Closely resembles the Early Oxheart in its general characters, but decidedly larger in all its parts, and maturing about ten days later; head compact, pale yellowish-green; outer head leaves overlapping at the top, sometimes recurving a little at the apex; outer leaves roundish or oval, sometimes nearly flat, occasionally spoon-form or reflexed, and somteimes much twisted and contorted; margin entire, border plain, apex usually emarginate; veins usually not conspicuous; stem rarely more than one-third the height of the head.

An excellent intermediate variety.

Correctly figured in The Vegetable Garden, p. 112; Les plantes potagères, p. 107.

No. 63. LINGREVILLE,—VEG. GAR.; Vil., '84, '85.

Syn. Fr. *Chou de Lingreville*, VIL., '84, '85; Ch. d'Ingreville, Vil.

An early cabbage, intermediate in its characters between Bacalan Late and Tourleville. Plant of medium size, rather dark green, little glaucous; head rather small, compact, of the oxheart shape; outer leaves rather numerous, stiff, roundish, often broader than long, flat, or reflexed spoon-form, smooth, border plain. The lower leaves are usually short-petioled.

No. 64. LITTLE PIXIE,—GREG., '82, '85, '86; Sib., '86; VIL.

Syn. Tom Thumb, Vil.

Plant small, dull dark green, scarcely glaucous; head small, of the Oxheart shape, compact; outer leaves nearly flat, roundish, margin entire, border plain.

This was formerly grown as an early cabbage, but has been largely superseded by Early Wakefield and other larger and earlier sorts.

Correctly figured in "Cabbages and How to Grow Them," p. 43.

No. 65. NONPAREIL, Vil.

Syn Barne's Early, BURR (d), Barne's Early Dwarf, *Burr* (d), Vil. *Early Nonpareil*, Burr (d); Greg., '83; *Nonpareil Early*, Greg., '85, '86; Nonpareil Improved, Vil.; Prince's Nonpareil, Vil.,; Fr. *Chou Nonpareil*, VIL., '85.

Resembles in general appearance the Early Wakefield. The head is a little shorter in proportion to its diameter, the outer leaves are possibly a little larger, rather more tapering at the base, and not quite so thick. In season it is usually a very little later than Early Wakefield.

No. 66. POMERANIAN,—BURR, GREG., Vil. '85.

Syn. Filder, VEG. GAR.; Vil.; *Filderkraut*, Sib., '83; Fielderkraut, GREG., (d); *Pointed Filderkraut*, Land., '86; *Pomeranian Pointed Head*, Vil., '84; *Suabian*, H. and S., '86; Fr. *Chou conique de Pomeranie*, VIL,, '84, '85; Ger. Filderkraut, Vil.; Pommerischer Spitz Kopfkohl, A. de Cl.; Pomersches spitziges Kraut, Vil.

Plant resembles in general appearance the Winnigstadt, but is somewhat larger in size; head oblong conical, very regular and symmetrical, pale, sometimes yellowish-green, extremely solid, usually slightly larger than that of the Winnigstadt; outer head leaves closely embracing, usually extending a little above the point of the head, as in the Winnigstadt, often forming a tubular or twisted projection; outer leaves very large, but not very numerous, growing nearly erect, and as high as the top of the head, strongly waved, suggesting the appearance of some of the larger cauliflowers; oval, with entire margin and apex, and undulate borders, veins usually not conspicuous; stem rather tall, often swollen below the head.

A very reliable intermediate variety, which when sown late, is good as a winter cabbage.

Correctly figured in The Vegetable Garden, p. 118; Les plantes potagères, p. 115.

No. 67. TOURLEVILLE—Vil., '84, '85; Greg., '85, '86; Sib., '83.

Syn. Early Tourleville, A. de Cl.; Tourleville Early, VEG. GAR.; Fr. *Chou de Tourleville*, Vil., '84, '85; Ch. prècose de Tourleville, A. de Cl.; Ger. Kopfkohl von Tourleville, A. de Cl.

Quite distinct in habit of growth, rather small size, dark green, scarcely glaucous; leaves thick and stiff; head distinctly conical, compact, pale green; outer head leaves loosely embracing, recurving at the apex; outer leaves few, loosely disposed, roundish, reflexed, often waved; border plain, surface nearly smooth, ribs large and round near the stem, which is medium in height.

A rather early cabbage; little grown in this country. It possesses no advantages over the Oxhearts.

Figured correctly in The Vegetable Garden, p. 111, and Les plantes potagères, p. 107, except that in both the leaves appear too much blistered.

No. 68. *Wheeler's Cocoanut*, Greg., '85, '86; Thor., '83.

Syn. *Wheeler's Imperial ?*, Vick, '85.

At the Station this cabbage appeared to be very closely allied to the Early Oxheart, differing less from that variety than different plantings of it differed from each other.

No. 69. WINNIGSTADT*—LAND., BURR, Vil., '84, '85; Till., '86.

Syn. *Early Cone*, Land., '85; *Early Winnigstadt*,* Brill, GREG., '85, '86; HEN., '86; Thor., '86; Till., '86; VEG. GAR.; Pointed Head, Burr; Fr. *Chou pointu de Winnigstadt*, VIL., '84, '85; Ger. Spitzes Winnigstadter Kraut, Vil.; Spitzes Windelsteiner Kr., Vil.; Spitzfelder Kr., Vil.; Winnigstadter fruher Kopfkohl, A. de Cl.

Plant medium in size, glaucous green, with a distinct bluish cast; head conical, pale green, remarkably solid; outer head leaves usually extending a little above the point of the head, forming a tubular projection of which the apex often recurves slightly; outer leaves growing on the average about half erect, roundish, flat or spoon-form, usually recurving slightly, border slightly ruffled, margin sinuate; veins rather conspicuous; stem rather short.

A second early variety noted for the solidity of its head, and its reliability for heading under varying conditions. It is also a good keeper, and sown late forms an excellent winter cabbage.

Correctly figured in The Vegetable Garden, p. 118; Les plantes potagères, p. 115.

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*Sometimes spelled Winningstadt.

†*Foliage washed with red.*

NO. 70. DARK RED POINTED HEADED—Vil., '85.

Syn. Dark Red Early Pointed Headed, A. de Cl.; Fr. *Ch. rouge conique*, Vil., '85; Ger. Fruher schwarzrother spitzer Kopfkohl, A. de Cl.

Plant rather large, inclining to upright, foliage pale green, strongly washed with purple, with purple ribs and veins; head oxheart shape, rich glossy purplish-red, remarkably compact; outer leaves roundish, reflexed, slightly blistered, borders strongly undulate, often approaching ruffled; stem rather long.

In habit, this cabbage bears a rather striking resemblance to Filderkraut, but it is somewhat smaller in size, and has a taller stem.

Correctly figured in Album des Clichés, Vil., No. 47,427.

SAVOY CABBAGES.

B. Foliage more or less strongly blistered.

II. Heads round or nearly so.

NO. 71. DRUMHEAD—BRILL.; BURR.; GREG., '85, '86; HEN.; LAND.

Syn. Cape, Burr., (not of Vil.); Large Drumhead, VEG. GAR., Vil.; *Large Vertus*, Vil., '85; *Large Vertus Drumhead*, Vil., '84; Fr. *Chou Milan des Vertus*, VIL., '84, '85; Ch. M. gros frisé d'Allemande, Vil.; Ch. de Paris, Vil.; Ger. Krauser allegroster Vertus Wirsing, A. de Cl.; Vertus oder Centner Wirsing, Vil.

Plant rather large, foliage very dull, rather dark green, scarcely glaucous, rather densely, prominently and finely blistered; head roundish or slightly flattened, pale green, very compact; outer leaves rather numerous, roundish or oval, flat or reflexed, sometimes spoon-form, border finely undulate, sometimes approaching ruffled; stem usually very short.

The degree of blistering of the leaves in this Savoy is rather intermediate, being decidedly greater than in the Norwegian, and considerably less than in the Victoria. It is very reliable for heading, rather late in season, and is said to keep well until spring. It is considered a standard sort wherever grown.

Correctly figured in The Vegetable Garden, p. 127; Les plantes potagères, p. 125.

No. 72. Dwarf Early—Vil., '84, '85.

Syn. Dwarf Green Curled, Vil.; Dwarf Early Green Curled, Veg. Gar.; *Early Dwarf*, Burr (d); Greg. (d), Sib., '83, Thor., '86; Early Flat Green Curled, Thomp., (d); Early Green, Burr (d); Fr. Chou Marcellin, Vil.; Ch. Milan court, Thomp. (d); *Ch. M. court hatif*, Vil., '84, '85; Ch. M. de Caen, Vil.; Ch. M. Nain, Vil.; Ch. M. trapu, Thomp. (d); Ger. Krauser niedriger Marcellin Wirsing, Vil.; Fruher Marcellin W., Vil.; Fruher niedriger Marcellin W., A. de Cl.

Plant vigorous, but low and spreading, dull green, scarcely glaucous, very densely, finely and prominently blistered; head somewhat flattened, pale green, moderately compact; outer head leaves scarcely meeting at the top, strongly recurved; outer leaves numerous, very large, roundish, often broader than long, limb reflexed, border undulate, margin sinuate; midribs and veins whitish-green, conspicuous; stem very short, the plant often appearing to rest on the ground.

Correctly figured in The Vegetable Garden, p. 125; Les plantes potagères, p. 122.

A second early variety of first quality; much grown for market about Paris.

No. 73. Green Globe—Burr, Hen., Vil., '84, '85.

Syn. Early Flat Green Curled, Veg. Gar.; Vil., (not of Burr); Green Curled, Burr; Large Green, Burr; *Netted?* Hen. '83, '86; Fr. *Chou Milan ordinaire*, Vil., '84, '85; Ger. Gewohnlicher Franzosischer Wirsing, A. de Cl.

Plant rather large and tall; foliage dull dark green, scarcely glaucous, densely and prominently blistered; head nearly round, moderately compact, pale green; outer leaves rather numerous, small, roundish, flat or reflexed, borders undulate; stem rather tall.

A very hardy and reliable Savoy. It attains its greatest perfection only late in the season, under the influence of cool and frosty weather.

Correctly figured in The Vegetable Garden, p 125; Les plantes potageres, p. 122.

No. 74. *Improved American*,—Greg., '83, '85, '86.

Syn. *Improved American Drumhead*, Hen., '86.

This appears to be an improved form of the Drumhead producing smaller outside leaves, and being rather more reliable for heading. At the Station, the plants have had a rather longer stem than those of the Drumhead.

Correctly figured in "Cabbages and How to Grow Them," p 54.

No. 75. LARGE HARDY WINTER DRUMHEAD,—VEG. GAR.; Vil., '84.

Syn. Large Late Hardy Winter, A. de Cl.; *Large Late Hardy Winter Drumhead*, Vil., '85; Fr. *Chou Milan de Pontoise*, VIL., '84, '85; Ger. Sehr spater Krauser Pontoise Wirsing, Vil.

Plant of rather large size, foliage deep bluish-green; prominently, but not very densely or finely blistered; head roundish or somewhat flattened, very compact, pale green; outer leaves numerous and large, oval, reflexed spoon-form; stem two to four inches long below the leaves.

Correctly figured in The Vegetable Garden, p. 127; Les plantes potagères, p. 125.

No. 76. LIMAY—VEG. GAR.

Syn. *Small Fine Curled Limay*, Vil., '84; *Very Curled Limay*, Vil., '85; Fr. *Chou Milan petit tres frise de Limay*, VIL., '84, '85; Ger. Sehr Krauser von Limay Wirsing, A. de Cl.

Plants quite dwarf, but of rather large size, resembling in color and habit the Tours Savoy, but more finely blistered; outer leaves numerous, growing nearly horizontal, reflexed, the lower ones resting on the ground, ribs sometimes tinted with purple.

Like the Tours Savoy this does not usually form a compact head, but it is not regarded as less valuable on this account.

Correctly figured in The Vegetable Garden, p. 126; Les plantes potagères, p. 124.

No. 77. NORWEGIAN—VEG. GAR.; Vil., '84, '85.

Syn. Norway, Vil.; Fr. *Chou Milan de Norvege*, VIL., '84, '85; Ger. Norwegischer sehr spater Wirsing, A. de Cl.

Plant rather large, foliage inclining to upright, very deep bluish-green; head roundish, very compact, pale green, often tinged with red at the top; outer leaves rather few, half erect, roundish, nearly flat, border plain or undulate, surface very little blistered for a Savoy; veins and ribs greenish white, rather conspicuous; stem rather long.

Rather intermediate between a cabbage and Savoy. Its taller stem, and slightly more abundant foliage, only distinguish it from the Vaugirard cabbage.

It is the latest of the Savoys, and the one that endures the most intense cold. Vil.

Correctly figured in The Vegetable Garden, p. 128; Les plantes potagères, p. 126.

No. 78. TOURS;—BURR, VEG. GAR.; Vil., '84, '85.

Syn. Dwarf Green Curled, Burr, (not of Vilmorin); Fr. *Chou pancalier de Touraine*, VIL., '84, '85; Ger. Krauser gruner von Tours Wirsing, A. de Cl.

Plant of medium size, very dwarf, foliage very dark green, inclining to bluish, blisters very prominent, dense; head rather small, round, yellowish green, rarely compact; outer leaves rather numerous, large, flat or reflexed, very spreading, the lower ones resting on the ground, border nearly plain.

Although this Savoy rarely forms a compact head, it is esteemed for its outer leaves, which, owing to the slight development of its ribs and veins, are scarcely less tender than those that form the head.

Correctly figured in The Vegetable Garden, p. 125; Les plantes potagères, p. 123.

No. 79. ULM, Land., '86; VEG. GAR.

Syn. *Early Ulm*, BURR; GREG., '85, '86; Sib., '83; Thor., '86; *Early Dwarf Ulm*, Hen., '86; Sib., '86; Thor., '86; Early Green Curled, Vil.; New Early, Thomp.; *Small Early Ulm*, Vil., '84, '85; Fr. Chou Milan hâtif d' Ulm, A. de Cl.; *Ch. M. petit hatif*, VIL., '84, '85; Ch. M. très hâtif d' Ulm, Vil.; Ger. Bamberger Wirsing, Vil.; Extra fruher Ulmer W., Vil.; Ganz fruher Ulmer Wirsing, A. de Cl.

Plant small, compact, deep green, scarcely glaucous; head quite small, round, very pale yellowish green, very compact; outer head leaves usually overlapping a little, apex slightly recurved; outer leaves few in number, small, half erect or less, often curving downward, roundish, often flat, sometimes inclining to spoon-form, and often reflexed; surface densely and prominently blistered, veins usually not conspicuous, midribs hidden in the compact foliage; stem usually very short.

The smallest and one of the earliest of the Savoys; of excellent quality, but generally considered too small for market.

Figured in The Vegetable Garden, p. 124; Les plantes potagères, Vil., p. 121. In our tests the stem has usually been rather shorter than the cut suggests.

No. 80. VERY EARLY PARIS, Greg., '83; VEG. GAR.; Vil. '84, '85.

Syn. *Chou* de *Milan tres hatif de Paris*, VIL., '84, '85; Ger. Fruhester Krauser Pariser Wirsing, A. de Cl.

Plant of medium size; stem rather tall; foliage very dark green, quite glaucous, with a slight bluish cast; head roundish, perfectly defined, very compact, very pale yellowish-green, resting in a basin of flaring, outcurving leaves, which are intermediate in color between the head and outer leaves; outer head leaves hood-shaped, usually overlapping, the outer one recurving, outer leaves somewhat less finely blistered than in the Ulm, distinctly petioled at the base, limb roundish, often broader than long, usually flat, strongly recurving at the apex, the tips of the lower leaves resting on the ground.

This is considered to be the earliest Savoy.

Correctly figured in The Vegetable Garden, p. 124; Les plantes potagères, p. 121.

NO. 81. VICTORIA, Bliss, '83; GREG.; VEG. GAR.; Vil., '85.

Syn. *Victoria Very Curled*, Vil., '84; Very Curled Victoria, A. de Cl.; Fr. *Chou Milan Victoria*, VIL., '84, '85; Ger. Extra Krauser Victoria Wirsing, A. de Cl.

Readily distinguished from all other Savoys by the extreme fineness of the blistering of the foliage. Plant of medium size; head roundish; rather compact, slightly paler than the outer leaves; the latter are numerous, about half erect, roundish or oval, flat or reflexed, border finely undulate; stem of medium height.

Of excellent quality, a good keeper, and stands cold and wet well. The outer leaves are sometimes cooked, and used in the same manner as the head.

Correctly figured in The Vegetable Garden, p. 125; Les plantes potagères, p. 123.

IV. Heads elliptical.

NO. 82. GOLDEN—BURR, GREG.; VEG. GAR.; Vil., '84, '85.

Syn. Blœmendale, Gar. Chron. Early Yellow, Burr; Thomp.; Vil.; Large Late Yellow, Burr; New Blœmendalers, Gar. Chron.; White, Burr; Yellow Gar. Chron. Yellow Curled, BURR, VEG. GAR., Vil.; Fr. Chou Milan de Savoie, Gar. Chron.; *Ch. M. dore*, Gar. Chron., VIL., '84, '85; Ger. Feiner gelber Wirsing, Vil.; Gelber Savoyer, Vil.; Goldgelber neidriger Wirsing, A. de Cl.; Holl. Gele Savooiekool, Vil.; Port. Saboia durada, Vil.

Plant rather large and tall, foliage pale green, sometimes inclining to yellowish, not glaucous, rather coarsely blistered; head slightly oblong, medium in size, not compact; outer leaves rather open. usually petioled at the base, oval, flat or spoon-form; stem short.

This Savoy is too late for culture in the Northern States. In France and England it is sufficiently hardy to endure the winter in the open ground, and hence is there very popular, as its numerous names indicate.

Correctly figured in The Vegetable Garden, p. 126; Album des Cliché, Vil., 47466.

V. Heads conical.

NO. 83. LONG HEADED,—VEG. GAR.; Vil., '84, '85.

Syn. Conical, Vil.; *Early Yellow Frankfort?*, Dam., '86; *Green Curled?*, Land., '86; *Strasburg*, '86; Fr. *Chou Milan a tete longue*, VIL., '84, '85; Ch. Milan pain de sucre, Vil.; Ger. Hafenkohl, Vil.; Langkopfiger Hafenkohl Wirsing, A. de Cl.; Strasburger, oder Frankfurter lang kopfiger, Vil.

Plant of medium size, tall, the foliage inclining to upright, dull, dark, slightly glaucous green ; head oblong oval, nearly in the form of the Sugar-loaf cabbage, pale yellowish-green, moderately compact ; outer head leaves overlapping, apex recurved ; outer leaves oval, or short spatulate, those about the head spoon-form, the others usually revolute on the borders ; surface densely and prominently blistered ; stem 3 to 5 inches long.

Of medium season and good quality.

Correctly figured in The Vegetable Garden, p. 127 ; Les plantes potagères, p. 124.

No. 84. FEATHER STEM—BURR, Thor., '83, '85.

Though generally called a Savoy, this plant is sufficiently distinct to form a class by itself. It is said to be a cross between the Savoy and Brussels Sprouts, and might be called a Brussels Sprouts with a Savoy leaf. Plant 12 to 18 inches tall, leaves large, deep bluish-green, little glaucous, spreading, oval, petioled or sessile, rather densely blistered, with entire margin and plain border. The smaller terminal leaves embrace each other loosely, forming the semblance of a head. The axillary buds are largely developed as in Brussels Sprouts, though as grown at the Station they did not usually form compact miniature heads.

No. 85. Besides the cabbages described in the foregoing list, six were grown of which the plants were too variable for description, as follows :

Bloomsdale Bullock Heart, Land., '84, '85, '86. Apparently allied to the Large Oxheart.

Early Bonanza, Buist, '86. Also allied to the Oxhearts.

Early Mongabella, Dam., '86. Seemed allied to the St. Denis.

Earliest Vesuvius, Dam., '86. A very large, flat-headed? bluish-green cabbage ; in season rather late.

Early Wymañ, Greg., '86; Sib., '86. Produced flattened round, and oxheart shaped heads. In season it was first early.

Erfurt Large Late, H. & S. Seemed allied to Brunswick Short-Stem, but was decidedly less dwarf.

Large Curled Wilson Savoy, Dam., '86.

INDEX OF THE NAMES OF CABBAGES.

The numbers refer to the numbers of the varieties in the described list.

Synonyms are printed in italics.

N. B.—The Savoy cabbages are indexed in a list by themselves.

Name.	No.
All Head	13
All Seasons	1
Amager	2
Amager Danish Winter Round	2
Amager rundes Winter kraut, oder kopfkohl (Ger.)	2
American Drumhead	19
American Green Glazed	40
Angelberger mittelfruhes kraut (Ger.)	30
Bacalan Early	55
Bacalan Large	52
Bacalan Late	52
Barne's Early	65
" " *Dwarf*	66
Bergen Drumhead	3
Berlin Large Dark Red	44
Berkshire Beauty	4
Bleichfelder kraut (Ger.)	39
Blenheim	59
Bloomsdale Bullock's Heart	85
Bloomsdale Brunswick	15
" *Early Market*	53
" *Early Drumhead*	30
" *Early Dwarf Flat Dutch*	6
Bloomsdale Large Late Flat Dutch	25
Bloomsdale Late Flat Dutch	25
Blutrothes grosses spates´ kraut (Ger.)	47
Braunschweiger weisses plattes kraut (Ger.)	6
Braunschweiger kurzbeiniger kopfkohl (Ger.)	6
Bridgeport Late Drumhead	18
Brill's Excelsior Flat Dutch	14
Bristol Flat Dutch	25
Bronski Russian	5
Bronski sehr fruhes spitzes russiches kraut (Ger.)	5
Brunswick Short Stem	6
Buist's Late Flat Dutch	25
" " *Drumhead Improved.*	18
Burpee's Early Advance	60
" *Short Stem Drumhead*	6
" *Superior Large Flat Dutch*	25
Burpee's Surehead	32

Name.	No.
Cannon Ball	37
Cavalo cappuccio grosse di Germania (Ital.)	26
Centner Kraut (Ger.)	26
Chou Bacalan gros (*Fr.*)	52
—— *Bacalan hatif* "	55
—— *Bacalan tardif* "	52
—— *cabus a pied court de Saint Flower* "	26
—— *cabus blanc a cotes bleues* "	26
—— *cabus blanc de montagne* "	25
—— *cabus gros de Laon* "	39
—— *capuch* "	43
—— *cœur de bœuf gros* "	62
—— *cœur de bœuf moyen de la halle* "	57
—— *cœur de bœuf petit* "	56
—— *Colas* "	42
—— *conique de Pomeranie.* "	66
—— *d' Aleth* "	16
—— *d' Alsace* "	26
—— *d' Angerville* "	55
—— *d' Aubervilliers* "	30
—— *de Battersea* "	59
—— *deBrunswick pied court* "	6
—— *de champ d'or* "	22
—— *de Chenillet* "	42
—— *de Constance* "	22
—— *de Dax* "	38
—— *de Fumel* "	16
—— *de Genille* "	42
—— *de Habas* "	17
—— *de Hollande pied court* "	39
—— *de Hollande tardif* "	25
—— *de Lingreville* "	63
—— *de Saint Brieuc* "	55
—— *de Saint Denis* "	30
—— *de Schweinfurt* "	28
—— *de Strasbourg* "	26
—— *des Vertus* "	30
—— *de Tourleville* "	67
—— *de Vaugirard* "	34
—— *d' hiver* "	34
—— *d' Ingreville* "	63
—— *d' York gros* "	51
—— *de York petit hatif* "	50
—— *femelle* "	16
—— *Jaunet* "	42

Name.	No.
Chou Joanet gros (Fr.)	43
—— *Joanet gros tardif* “	43
—— *Joanet tardif* “	43
—— *marbre de Bourgogne.* “	22
—— *marbre de Saint Claude* “	22
—— *nantaise* “	42
—— *noiraitre* “	48
—— *nonpareil* “	65
—— *pain de sucre* “	49
—— *petit hatif d'Erfurt* “	8
—— *pointu de Winnigstadt* “	69
—— *pomme blanc gros plat de Magdeburg* “	19
—— *pomme blanc quintal d'Ulm* “	33
—— *pomme d'Angers* “	42
—— *pomme de craon* “	55
—— *precose de Tourlevill* “	67
—— *quintal* “	26
—— “ *gros d'Allemande* “	26
—— *rouge conique* “	70
—— “ *fonce hatif d'Erfurt* “	45
—— “ *gros* “	46
—— “ *petit* “	48
—— “ *petit d'Utrecht* “	48
—— *tabouret* “	6
—— *tres hatif d'Etampes* “	69
—— *vert d'Amerique* “	
Couve branco d'Alsacia (Port.)	
——— *vermellho escuro pequeno d'Utrecht* “	48
——— *vermellho grande* “	47
Danish Drumhead	7
Dark Red Early Pointed Headed	70
“ *Drumhead*	47
“ *Dutch*	48
Dark Red Pointed Headed	70
Dax	38
Dax Drumhead	38
“ *Very Large Late*	38
Drumhead Early Dutch	39
“ *Quintal*	26
Earliest Blood Red Erfurt	45
Earliest Dwarf Conical German	54
“ Vesuvius	85
“ White Erfurt	8
Early Bacalan	55
“ Bleichfield	9
Early Bleichfield Giant	9
“ *Blood Red Erfurt*	45
Early Bonanza	85
Early Cone	69
“ *Dark Red Dutch*	48
Early Dark Red Erfurt	45
“ Deep Head	10
Early Drumhead	11
Early Drumhead	17, 30, 42
Early Dutch Drumhead	39
Early Dwarf Dutch	26
“ “ *Flat Dutch*	12
“ “ *Red*	45
Early Dwarf York	50
Early Etampes	60
Early Flat Dutch	30
Early Flat Dutch	12
Early French Oxheart	56
Early Jersey Wakefield	58
Early Low Dutch	39
Early May	50
Early Mongabella	85
Early Nonpareil	65
Early Oxheart	56
Early Paris	57
Early Paris Market	57
Early Schweinfurt	28
Early St. John's Day	42
Early St. John's Day Drumhead	42
Early Sugar Loaf	49
Early Summer	13
Early Tourleville	67
Early Wakefield	58
Early Winnigstadt	69
Early Wyman	85
Early York	50
Early York Dwarf	50
Early York English	50
Enfield Market	59
English Early York	50
Erfurt Large Late	85
Erfurter blutrothes fruher Salat Kraut (*Ger.*)	45
Erfurter kleines fruhestes festes niedriger Kraut (*Ger.*)	8
Etampes	50
Everitt's Mammoth Large Late Flat Dutch	25
Excelsior	14
Excelsior Flat Dutch	14
Excelsior Large Late Flat Dutch.	14
Excelsior Late Flat Dutch	14
Femel	16
Fielderkraut	66
Filder	66
Filderkraut (Ger.)	66
Fine Large Flat Dutch	25
Fine Red Dutch	48
Fottler's Brunswick	15
Fottler's Early Brunswiek	15
Fottler's Early Drumhead	15
Fottler's Improved Brunswick	15
Fottler's Improved Early Brunswick	15

Name.	No.
French Oxheart	62
Fruher Bacalaner Kopfkohl (Ger.)	55
Fruher Habas Kopfkohl "	17
" *Johannistag Kopfkohl* "	42
" *Pariser Markt, Kopfkohl* "	57
" *schwarzrother spitzer Kopfkohl* "	70
" *Zucker Maispitzkohl* "	50
Fruhes Bacalaner Kraut "	55
" *grosser Ochsenherz Kraut* "	62
" *kleines Ochsenherz Kraut* "	56
Fumel	16
Fumel niedriger oder femelle (Ger.)	16
Garfield Pickler	46
Garfield Pickling	46
Great American	18
Green Glazed	40
Green Glazed American	40
Griechisches Centner Kraut (Ger.)	30
Groote late roode kool (Holl.)	47
Gros chou d'Allemande (Fr.)	26
Grosser Bacalaner Kopfkohl (Ger.)	52
" *Johannistag Kopfkohl* "	43
" *Ochsenherz Kopfkohl* "	62
Grosses Bacalaner Kraut "	52
" *spates hollandisches Kraut* "	25
Grunglaisirter Americanischer Winter Kopfkohl "	40
Habas	17
Habas Drumhead	17
" " *Early*	17
Henderson's Early Summer	13
" *Premier*	60
" *Selected Early Jersey Wakefield*	58
" *Selected Late Flat Dutch*	25
Hollandischer grosser spater Kopfkohl (Ger.)	25
Hollandischer neidriger Kopfkohl "	39
Hollandisches neidriger plattes Kraut "	39
Hundred Weight	26
" " *Drumhead*	26
Improved Drumhead	18
Jersey Wakefield	58
Johnson and Stoke's Earliest	60

Name.	No.
King of the Cabbages	59
Kleiner fruher weisser Erfurter Kopfkohl (Ger.)	8
Kleiner Ochsenberg Kopfkohl "	56
Kleines zwarte utrechtische roode kool (Holl.)	48
Landreth's Earliest	60
Landreth's Early Summer Flathead	13
Landreth's Large Late Mountain	18
Landreth's Large York	51
Landreth's Mammoth Bergen	3
Large Bacalan	52
Large Bergen	3
Large Bergen Drumhead	3
Large Blood Red	47
Large Brunswick Short-Stemmed	6
Large Early Schweinfurt	28
Large Early York	51
Large Flat Dutch	25
Large French Oxheart	62
Large German Drumhead	3
Large Jersey Wakefield	61
Large Late Bergen	3
Large Late Drumhead	6, 43
Large Late Drumhead	18
Large Late Flat Dutch	25
Large Oxheart	62
Large Red Drumhead	47
Large Red Dutch	47
Large Red Dutch Pickling	47
Large White Brunswick	19
Large White Solid Magdeburg	19
Large York	51
Late American Drumhead	18
Late Flat Dutch	25
Late Flat Dutch Drumhead	25
Late Mountain	18
Lingreville	63
Little Pixie	64
Long Island Medium Flat Dutch	14
Louisville Drumhead	20
Louisville Early Drumhead	20
Low's Early Peerless	21
Magdeburger grosstes weisser plattes Kopfkohl (Ger.)	19
Mammoth Rock Red	49
Marbled Bourgogne	22
Marbled Burgundy	22
Marbled Burgundy Drumhead	22
Marblehead Dutch	25
Marblehead Mammoth	23
Marblehead Mammoth Drumhead	23
Mason's Drumhead	26
Maule's Surehead	32

Name.	No.
Newark Early Flat Dutch	24
New Peerless Early	21
Nonpareil	65
Nonpareil Early	65
Nonpareil Improved	65
Oxheart Early	56
Oxheart French	56
Oxheart Large	62
Padilla Purple Pickling	47
Paris Market Very Early	57
Pickling	47
Pointed Head	69
Pomeranian	66
Pomeranian Pointed Head	66
Pomerisches spitziges Kraut (Ger.)	66
Pommerischer spitz Kopfkohl "	66
Premium Flat Dutch	25
Prince's Nonpareil	65
Quintal	3
Quintal Drumhead	26
Rawson's Early Summer	13
Red Drumhead	47
Red Dutch	48
Red Dutch Pickling	48
Red for Pickling	48
Red Pickling	48
Rother grosser Kopfkohl (Ger.)	47
Rothmarmorirter Burgunder Kopfkohl (Ger.)	22
Round Schweinfurt	13
Russian Flat Giant	26
Russian Round Giant	40
Saint Denis Grosser Kopfkohl (Ger)	30
Schwarzrother Erfurter Kopfkohl (Ger.)	45
Schweinfurs Largest White	28
Schweinfurt	28
Schweinfurter fruhes grosses Kraut (Ger.)	28
Schweinfurter sehr grosses fruher Kopfkohl (Ger.)	28
Schweinfurth	28
Schweinfurt Quintal	28
Schweinfurt Quintal Drumhead	28
Sehr fruher Etampes Kopfkohl (Ger.)	60
Select Very Early Jersey Wakefield	58
Short Stem Drumhead	6
Sibley's Premium Large Late Flat Dutch	25
Silverleaf Drumhead	29
Small Oxheart	56
Small Red	45
Spater Dax Kopfkohl (Ger.)	38
Spitzes Windelsteiner Kraut "	69
" *Winnigstadter Kraut* "	69
Spitfelder Kraut "	69
St. Denis Drumhead	30
St. Denis Large Drumhead	30
" " *Early Drumhead*	30
St. John's Day Dwarf	42
" " " *Drumhead.*	42
St. John's Day Early	42
St. John's Day Early Drumhead.	42
" " *Large Drumhead.*	43
St. John's Day Late	43
St. John's Day Late Drumhead	43
Stone Mason	31
Stone Mason Drumhead	26
Straatsburger Kool (Holl.)	26
Strassburger Centner Kraut (Ger.)	26
" " *sehr grosser Kopfkohl* (Ger.)	26
Suabian	66
Sugar Loaf	49
Surehead	32
Tom Thumb	64
Tourleville	67
Tourleville Early	67
True Early Jersey Wakefield	58
Ulmer grosses spates Centner Kraut (Ger.)	33
Ulm Quintal	33
Utrechter kleines schwarzrothes Kraut	45
Utrecht Red	45
Vanack	59
Vaugirard	34
Vaugirard Winter	34
" " *Drumhead*	34
Very Early Etampes	60
" *Dwarf Early Erfurt*	8
" *Early Paris Market*	57
Vilmorin's Early Flat Dutch	35
Vroege suikerbroad kool	49
Warren	36
Warren's Stone Mason	36
Wheeler's Cocoanut	68
Wheeler's Imperial	68
Winnigstadt	69
Winnigstadter fruher Kopkohl (Ger.)	69
Yorker fruher Zwerg Kopfkohl (Ger.)	50
Yorker grosses Kopfkohl (Ger.)	51

Name. No.
York'sches allerfruhester weisses Kraut (Ger.) 50
York'sches grosses Kraut (Ger.) 51

Zuckerhaut Kraut)Ger.) 49
Zuckerhut fruher Kopfkohl (Ger.) 49

SAVOYS.

Bamberger Wirsing (Ger.) 79
Bloemendale 82

Cape 71
Chou de Paris (Fr.) 71
—— *frise pointu* " 83
—— *Marcellin* " 72
—— *Milan a tete long* " 83
—— —— *court* " 72
—— —— *court hatif* " 72
—— —— *de Caen* " 72
—— —— *de Norvege* " 77
—— —— *de Pontoise* " 75
—— —— *de Savoie* " 82
—— —— *des Vertus* " 71
—— —— *dore* " 82
—— —— *gros frise d'Allemande* " 71
—— —— *hatif d'Ulm* " 79
—— —— *Nain* " 72
—— —— *ordinaire* " 73
—— —— *pain de sucre* " 83
—— —— *petit hatif* " 79
—— —— *petit tres frise de Limay* " 76
—— —— *trapu* " 72
—— —— *tres hatif de Paris* " 80
—— —— *tres hatif d'Ulm* " 79
—— —— *Victoria* " 81
Chou pancalier de Touraine " 78
Conical 83

Drumhead 71
Dwarf Early 72
Dwarf Early Green Curled 72
Dwarf Green Curled 72, 78

Early Dwarf 72
" " *Ulm* 79
" *Flat Green Curled* 72, 73
" *Green* 72
" " *Curled* 79
" *Ulm* 79
" *Yellow* 82
" " *Frankfort* 83
Extra fruher Ulmer Wirsing (Ger.) 79
" *krauser Victoria Wirsing* " 81

Name. No.
Feather Stem 84
Feiner gelber Wirsing (Ger.) 82
Fruher Marcellin Wirsing " 72
" *neidriger Marcellin Wirsing* " 72
Fruhester krauser Pariser Wirsing " 80

Ganz fruher Ulmer (Ger.) 79
Gelber Savoyer " 82
Gele Savooiekool (Holl.) 82
Gewohnlicher Franzosicher Wirsing (Ger.) 75
Golden 82
Goldgelber neidriger Wirsing (Ger.) 82
Green Curled 73, 83
Green Globe 73

Hafenkohl (Ger.) 83

Improved American 74
Improved American Drumhead 74

Krauser Allergrosster Vertus Wirsing (Ger.) 71
Krauser gruner von Tours " 78
" *niedringer Marcellin Wirsing* " 72

Langkopfiger Hafenkohl Wirsing (Ger.) 83
Large Curled Wilson 85
Large Drumhead 71
" *Green* 73
Large Hardy Winter Drumhead 75
Large Late Hardy Winter 82
" " " " *Drumhead* 75
" " *Yellow* 82
" *Vertus* 71
" " *Drumhead* 71
Limay 76
Long Headed 83

New Bloemendalers 82
New Early 79
Netted 73
Norway 77
Norwegian 77
Norwegischer sehr spater Wirsing (Ger.) 77

Saboia durada (Port.) 82
Sehr spater krauser Pontoise Wirsing (Ger.) 75
Sehr krauser Von Limay Wirsing " 76
Small Early Ulm 79

Name.	No.	Name.	No.
Small Fine Curled Limay	76	*Vertus oder Centner Wirsing* (Ger.)	71
Strasburger	73	*Very Curled Limay*	76
" *oder Frankfurter lang kopfiger Wirsing* (Ger.)	83	Very Early Paris	80
		Victoria	81
Tours	78	*Victoria Very Curled*	81
		Yellow	82
Ulm	79	" *Curled*	82

LETTUCE.

Of lettuce seventy samples bearing names not before received at the Station were grown and also several of standard varieties tested in previous years, for comparison of these. As appears from the table, most of our lettuces came from Germany and Italy, and from the number of synonyms among these, it is very evident that the condition of lettuce nomenclature in those countries is no better than in our own. It is surprising that of the sixty lettuces received from Germany and Italy, bearing names not before tested at the Station, all but ten were referred with considerable certainty to varieties which have already been grown and described at the Station, or else were Synonyms of one of these ten. The data noted appear in the following table. In order to economize space, the synoyms are appended in the broad column at the right, in which the numbers refer to the numbers of the varieties in the described list as published in the Station report for 1885, pp. 141–173.

LETTUCE—A TEST OF VARIETIES.

NAME. Varieties that formed no heads are printed in italics.	Seeds from.†	Of edible sizes in — days.	Begun to form flower stalks in —days.	Days fit for table use.	First bloom in — days.	Last seeds ripe in — days.	The numbers appended refer to the numbers of the varieties in our described lists. See Report N. Y. Agl. Experiment Station, '85, pp. 141–177 A SYNONYM OF
Alexander's White..........	Dam.	40	90	50	87	157	White Summer No. 65.
Am. Giant Brown Edge.....	Ben.	40	91	51	113	157	White Batavian No. 61.
American Giant, W. S.......	Dam.	41	90	49	104	156	“ “ “ “
Asparagus Cos	Ben.	40	70	30	91	157	Deer Tongue No. 69.
Australian Gathering	H. & S.	40	91	51	118	157	Early Simpson No. 20.
Australian Yellow Curled ...	Ben.	40	91	51	118	157	“ “ “ “
Batavian Red Edged	Ben.	40	87	47	109	151	White Batavian No. 61.
Berlin (Station No. 1)........	....	40	87	47	110	144	
Blood Red Large	Ben.	38	83	45	103	152	
Brown German Winter......	Dam.	41	66	25	90	122	
Brown Stubborn Headed ...	Ben.	38	87	47	118	144	
*Brown Stubborn Headed...	Batch.	32	85	53	......	......	
Burpee's Golden Heart......	Burpee.	38	87	49	112	144	Golden Heart No. 72.
Burpees Silver Ball..........	“	39	91	52	125	blgtd.	White Chavigne No. 63.
Butter	Land.	38	87	49	115	“	
Californta Gathering	H. & S.	41	84	43	134	“	Green Fringed No. 27.
Cooling's Leviathan.........	Dam.	41	88	47	118	150	Bath Cos B. S. No. 67.
Curled Leaved	“	41	68	27	96	152	
Drumhead..................	Greg.	48	80	32	90	143	Malta No. 40.
Early Butterhead............	“	40	84	44	100	151	Imperial No. 32.
“ Paris Market..........	Dam.	40	66	26	84	131	Red Edged Victoria No. 49.
Egg' Small Early Solid......	Ben.	40	68	28	103	138	
Emperor Frame Cabbage...	Greg.	42	59	17	81	130	Tennis Ball No. 55.
Erfurt Yellow..............	Ben.	40	84	44	112	152	White Summer No. 65.
Eureka.....................	Liv.	38	84	46	104	143	
Fearnought	H. & S.	40	84	44	112	153	Berlin No. 1.
Finest Moss Curled..........	Dam'	47	59	12	81	134	
Forcing Emperor Ear. Yellow	Ben.	40	61	21	81	131	Dippe's Emperor No. 17.
French Imperial Head	Greg.	38	87	49	121	157	Imperial No. 32.
Golden Head	Liv.	41	87	46	112	156	Early Simpson No. 20.
Golden Stone Head	Thor.	40	74	34	99	143	
Grand Admiral or Cyrius ..	Ben.	39	91	52	120	151	Large White Stone Summer [No. 35
Gray Seeded Butter (Sta. 24)	....	40	83	43	117	154	
*Green Unctous Cabbage....	Batch.	32	85	53	......	......	Green Fat No. 26.
Hammersmith (Station No. 30)	....	41	71	30	88	132	
Hanson....................	Greg.	40	81	41	103	140	
Hardy White Dutch.........	Ben.	38	87	43	113	151	Crisp German No. 13.
Henderson's New York......	Hen.	37	90	53	119	143	Neapolitan No. 43.
Imperial Brown Cos.	Dam.	39	93	54	119	155	Bath Cos B. S. No. 67.
Improved Spotted or Tigred.	Ben.	39	83	44	111	144	Improved Spotted W. S. No. 33
Johnson's Standwell	J. & S.	39	83	44	103	151	Golden Heart No. 72.
Large Brown Coblentz	Dam.	38	83	45	109	142	Mogul ? No. 41.
Large Brown Trotzkopf.....	“	38	90	52	128	150	Brown Stub. Headed, Ben.'86
Large Egg Frame...........	“	39	74	35	91	156	Egg Small Early Solid “ “
Large Green Pepignan	Ben.	39	83	44	108	155	Imperial No. 32.
Large Yellow Butter...... ..	Thor.	38	83	45	109	149	Gray Seeded Butter No. 24.
Large Yellow Coblentz......	Dam.	39	83	44	111	142	
Large Yellow of Dresden ...	“	39	83	44	109	151	White Summer No. 65.
Large Yellow Prince's Head	“	48	86	42	121	153	“ “ “ “
Large Yellow St. Angelo.....	“	39	86	47	114	153	Large St. Angelo No, 43.
Large Yellow Trotzkopf.....	“	39	86	47	114	142	White Summer No. 65.
Loco Foco..................	Carp.	37	85	48	114	151	Neapolitan No. 43.
London White..............	Dam.	39	83	44	114	140	White Summer No. 65.

*Planted May 13.

†For explanation of abbreviations see close of this report.

LETTUCE—A TEST OF VARIETIES.

NAME. Varieties that formed no heads are printed in Italics.	Seeds from.	Of edible sizes in —days.	Com. to form flower stalk in—days.	Days fit for table use.	First bloom in—days.	Last Seeds ripe in —days.	The numbers appended refer to the numbers of the varieties in our described lists. See Report N. Y. Agl. Experiment Station, pp. 141-177. A SYNONYM OF
Maddaloni	Dam.	39	63	24	86	128	
Maderia, (Station No. 39)	... ..	38	63	25	84	128	
Malta, (Station No. 40)	....	39	65	26	93	132	
Marblehead Mammoth Cab'g	Greg.	38	84	46	119	140	White Batavian No. 61.
Naples......................	Dam.	39	86	47	116	152	Neapolitan No 43.
Neapolitan, (Station No. 43) .	....	40	83	43	111	149	
New Perpetual	Burpee	39	86	47	112	150	Early Simpson No. 20.
Non Plus Ultra.............	Dam.	42	90	48	128	151	Large White Stone Summer [No. 35.
Oak Leaved	Beyer.	39	90	51	121	151	
Oak Leaved Yellow.........	H. & S.	38	61	23	75	123	
Palatine, (Station No. 45)....	....	40	83	43	100	135	
Paris Sugar	Ben.	38	86	48	117	142	Large White Stone Summer [No. 35.
Passe-Partout	Dam.	39	83	44	103	140	Berlin No. 1.
Perpignan..................	Greg.	39	83	44	116	143	Red Edged Victoria No. 49.
Perpignan..................	Dam.	39	98	59	bligh	ted	
Perpignan Improved........	Ben.	39	98	59	163	155	Perpignan, Dam. '86.
Perpignan Red Fringed.....	"	38	83	45	115	144	Red Edged Victoria, No. 49.
Potenza	Dam.	39	67	28	84	143	
Roman Tender Yellow	"	39	90	51	117	142	White Paris Cos.? No. 82.
Royal Red Fringed..........	Ben.	37	61	24	83	126	Red Edged Victoria No. 49,
Satisfaction Large Yellow ..	"	37	80	43	108	blgtd	Tom Thumb No. 57.
Sluggard	H. & S.	37	90	53	121	151	Lg. White Stn. Summer No.35
Speckl'd E'rly Dutch But'rhd	Land.	35	68	33	91	135	Maddaloni, Dam. '86.
Stonehead Golden Yellow...	Burpee	37	65	28	98	133	Golden Stone head.
Stubborn Headed Lg. Yellow	Ben.	37	86	49	111	147	Lg. White Stn. Summer No.35
Switzerland Large Solid.....	"	39	65	26	111	147	White Summer No. 65.
Tancrede Cos...............	Dam.	40	83	43	102	135	White Paris Cos.? No. 82.
Tender Brown American....	"	39	87	48	119	142	Prize Head No. 47.
Tender Yellow Californian..	"	40	90	50	131	155	Green Fringed No. 27.
Tennis Ball, (Station No. 55).	....	40	61	21	86	128	
Tomhannock	Burpee	37	83	46	103	139	Sugar Loaf No. 54.
West Indian................	H. & S.	37	90	53	123	142	The Deacon No. 56.
White Summer........... ..	Ben.	37	94	37	100	134	Large White Stone Summer ? [No. 35.
White Summer, (St. No. 65)..	....	40	83	43	116	142	
White Summer of Rome	Dam.	40	83	43	103	140	Golden Heart No. 72.
Yellow Australian	"	40	86	46	121	151	Green Fringed No. 27.
Yellow German Winter	"	39	86	47	116	149	Lg. White Stn. Summer No.35
Yellow Red Fringed.........	"	38	65	27	84	126	Maddaloni Dam. '86.
Yellow Seeded Butter	Hen. '83	38	84	46	117	151	Gray Seeded Butter No. 24.

As a supplement to the descriptions of last year, notes upon the hitherto untested varieties are added as follows :

Blood Red Large, Ben., '86 differed only in size from the Blood Red Small of our list.

Brown German Winter, Dam., '86 resembled our Roquette, with the exception that the leaves were bordered with brown.

Brown Stubborn Headed, Batch., '86 Ben., '86. Syn. Large Brown Trotz-kopf, Dam., '86, was a large, fine heading, enduring summer lettuce, with leaves rather strongly washed with brown.

Curled Leaved, Dam., '86, suggested a poor strain of Early Curled Silesian, but it was distinct from that variety. It ran to seed without heading.

Egg Small Early Solid, Ben., '86. Syn. Large Egg Frame Dam., '86, was only distinguishable from our Golden Stone Head by its stem leaves, after it had formed the flower stalk.

Eureka, Liv., '86, was a very distinct summer lettuce with foliage strongly washed with bright red, and formed fine, large and enduring heads.

Finest Moss Curled Dam., '86, closely resembled our Curled Cutting, but the leaves were perhaps more finely cut.

Large Yellow Coblentz, Dam.,'86, rather closely resembled Brown Stubborn Headed, but was distinctly smaller in size.

Maddaloni, Dam., '86, Syn. Speckled Early Dutch Butterhead, Land., '86; Yellow Red Fringed, Dam., '86, was a rather small, dull green, poor heading lettuce, with the inner leaves slightly washed with brown. It ran to seed immediately after heading and was strong in flavor.

Oak-Leaved, Beyer, '86, was paler in color, larger in size, and much slower in running to seed than the Oak-Leaved of our list.

Perpignan, Dam., '86, was a large, fine heading variety, of which the leaves were rather distinctly spotted with brown in the young plant, but the spots disappeared at a later stage of growth.

Potenza, Dam., '86, was a Cos lettuce, of the Paris Cos type, but with the peculiar brownish-green color of the Brown Batavian.

The American Giant Dam.,'86, and American Giant Brown Edged, Ben.,'86, synonyms of our White Batavian were very poor strains of that variety, heading poorly and soon running to seed. The Marblehead Mammoth Cabbage, Greg., '86, was by far the finest strain of this excellent lettuce that I have seen.

The Forcing Emperor Earliest Yellow, Ben., '86, very closely resembled our Dippe's Emperor, but the plants ran to seed without heading.

From the test of the past season, it is evident that the Hanson of our 1885 list is really not distinct from the Curled Simpson, and that our Stone Head Golden Yellow is the same as Golden Stone Head.

EXPLANATION OF ABBREVIATIONS.

In order to economize space, the following abbreviations of the names of seedsmen and nurserymen are used in the reports of the horticulturist and assistant horticulturist.

An abbreviation of the name of a seedsman attached to a variety with a date, indicates that the seed was obtained from that source, in the year specified, and under the name to which the abbreviation is appended. When no date is appended, it is understood to be 1886. In the case of fruits the abbreviation indicates the source of the plants.

Ang.—C. W. Angell, Oshkosh, Wis.
Batch.—D. Batchelor, Utica, N. Y.
Ben.—Ernest Benary, Erfurt, Germany.
Beyer.—Hugo Beyer, New London, Henry Co., Iowa.
Brill.—Francis Brill, Riverhead, Long Island.
Buist.—Robert Buist, Jr., Philadelphia, Pa.
Carp.—Chas. Carpenter, Kelley's Island, O.
Cleve.—A. B. Cleveland, Cape Vincent, N. Y.
Dam.—Damman & Co., Portici, Italy.
Dep't. Agl. or D. of Agr.—Department of Agriculture.
Dreer.—Henry A. Dreer, Philadelphia, Pa.
Ev't.—J. A. Everitt & Co., Watsontown, Pa.
Farq.—R. & J. Farquhar & Co., Boston, Mass.
Ferry.—D. M. Ferry & Co., Detroit, Mich.
Foote.—A. J. Foote, Terre Haute, Ind.
Green.—Green's Nursery Co., Rochester, N. Y.
Greg.—J. J. H. Gregory, Marblehead, Mass.
Hen.—Peter Henderson & Co., New York, N. Y.
H. & S.—Haage & Schmidt, Erfurt, Germany.
Hors.—F. H. Horsford, Charlotte, Vt.
J. & S.—Johnson & Stokes, Philadelphia, Pa.
Land.—David Landreth & Sons, Philadelphia, Pa.
Liv.—A. W. Livingston's Sons, Columbus, O.
Lovett.—J. T. Lovett, Little Silver, N. J.
Maule.—Wm. Henry Maule, Philadelphia, Pa.
Mun.—T. V. Munson, Denison, Tex.
Purdy.—A. M. Purdy, Palmyra, N. Y.
Pow.—E. P. Powell, Clinton, N. Y.
Raw.—W. W. Rawson & Co., Boston, Mass.
R. N. Y.—Rural New Yorker, New York, N. Y.
S. & F.—Schlegel & Fottler, Boston, Mass.
Sib.—Hiram Sibley & Co., Rochester, N. Y.
Sta.—Station.
Swan.—Benj. Swan, Oyster Bay, Long Island.
Tay.—S. A. Taylor, Fitzwilliam Depot, N. H.
Thor.—J. M. Thorburn & Co., New York, N. Y.
Till.—I. F. Tillinghast, LaPlume, Pa.
Till.—A. G. Tillinghast, Padilla, Skagit Co., W. T.
Van.—C. L. VanDuzen Nursery Co-, Geneva, N. Y.
Vick.—James Vick, Rochester, N. Y.
Vil.—Vilmorin, Andrieux et Cie, Paris, France.

Report of the Assistant Horticulturist.*

The amount of regular routine work rendered necessary in taking the notes of the horticultural work the past season prohibited my carrying on special investigations. The data given in the various tabular work required the closest scrutiny of the various plants from the time of the first germination until they reached their full maturity, this of itself necessitated daily inspection of the entire fruit and vegetable garden.

The season has been very favorable to the development of the garden crops; especially the egg-plant, pepper, melon and cucurbits generally.

The data noted in this report are of the same character as those recorded in the report of last year.

For convenience of reference, the explanation of the abbreviations used by Mr. Goff and myself, is placed at the end of the report of the horticulturist.

BEET.

In testing the varieties of beets and mangels, seed from 21 differently named packages of beet and 7 of mangel were planted Apr. 17, in rows twelve feet long and twenty-one inches apart, one row of each name. A liberal dressing of well rotted stable manure was spread upon the land in the fall of 1885, and plowed under as soon as applied. Before planting in the spring, the soil was thoroughly cultivated, but not plowed. The ground was kept free from weeds and the plants were thinned to six inches apart.

The date when the roots of each row were of edible size, and the number and average weight of the roots harvested were as follows :

---

*M. H. Beckwith.

BEET.	Seed from.	Of edible size.	Days from planting.	No. of roots	Average weight in ounces.
Bastion's Early Blood Turnip	Greg.	June 23	67	31	23
Bastion's Extra Early	Hen.	" 25	69	27	15
Bastion's Half Long Blood	Greg.	" 28	72	28	27
Burpee's Early Turnip	Burpee.	" 23	67	33	18
Burpee's Improved Blood Turnip	"	" 25	69	33	21
Dewing's Early Blood Turnip	Greg.	" 28	72	17	25
Early Blood Red	Land.	" 24	68	17	39
Early Blood Turnip	Greg.	" 28	72	32	21
Half Long Blood	Land.	" 30	74	33	25
Henderson's Pineapple	Greg.	" 30	74	36	25
Landreth's Very Early Forcing	Land.	" 23	67	32	20
Long Blood Red	"	" 30	74	43	18
Long Smooth Dark Blood	Greg.	" 30	74	39	20
New Eclipse	Burpee.	" 22	66	27	34
New Round Egyptian or Atlas	Dam.	" 23	67	30	20
New Round Trevis	"	" 30	74	49	21
Philadelphia Early Turnip	Land.	" 23	67	39	21
Pine Apple	Hen.	" 30	74	49	14
Round Early Red Naples	Dam.	" 28	72	46	22
Round Yellow Turnip	Greg.	" 28	72	36	27
Veitch's Chelsea	Ben.	July 2	106	51	14

MANGEL WURTZEL.

	Seeds from.	Number of roots.	Av. weight in ounces.
Dobitos Golden Globe	H. & S.	20	53
Erfurt Long Smooth Red	"	21	43
Golden Mammoth	"	17	45
Obendorf Red	"	21	47
Obendorf White	"	22	53
Obendorf Yellow	"	21	56
Wroxton's Orange Globe	"	22	58
SUGAR BEET.			
Small White Mangleben Curled Leaved. (Ger. Zucker-Runkel ruben, reinweisse klein. wanzlebener.) (Fr. Betterave blanche a sucre petite de wanzleben, a fenilles frisces)	Ben.	25	28

SYNONYMS.

Bastion's Early Blood Turnip, *Greg.*, Bastion's Extra Early, *Hen.*, Burpee's Early Turnip, *Burpee*, were not perceptibly different.

Burpee's Improved Blood Turnip, and Early Blood Red, *Land.*, were apparently the same.

Dewing's Early Blood Turnip, *Greg.*, and Early Blood Turnip, *Greg.*, appear to be the same.

Bastion's Half Long Blood, *Greg.*, and Half Long Blood, *Land.*, appeared to be identical.

I could detect no difference in the appearance of Long Smooth Dark Blood, *Greg.*, and Long Blood Red, *Land.*

A few roots of New Eclipse, *Burpee*, were rather more symmetrical and larger than New Round Egyptian or Athens, *Dam.*, otherwise there was no difference.

Landreth's Very Early Forcing, *Land.*, was apparently the same as the Philadelphia Early Turnip, *Land.*

CARROT.

Seeds of the following list of carrots were planted April 17 in the same manner as the beet. The plants were thinned to six inches apart in the rows. The same data are given in the table as for the beets.

CARROT.	Seed from.	Of edible size	Days from planting.	Number of roots.	Av. wt. per root in ozs.
Blunt Rooted Early Scarlet Horn	Land.	July 18	92	59	6
Early Very Short Scarlet......... ...	Greg.	" 13	87	32	6
Guerande	"	" 13	87	35	12
Long Yellow Saalfeld. (Ger. Saalfelder, blassgelbe dicke). (Fr. jaune pale de Saalfeld)....	Ben.	" 13	87	46	12
Pointed Rooted Early Scarlet Horn ..	Land.	" 10	84	60	7
Saalfeld	H. & S.	" 18	92	67	10
Yellow Intermediate. (Ger. Halblange gelbe spitz). (Fr. jaune demi-longue pointue)	Ben.	" 13	87	65	8

SYNONYMS.

Saalfeld, *H. & S.*, was apparently the same as the Long Yellow Saalfeld, *Ben.*

RADISH.

The early planting of radish was omitted this season, as it has nearly always proved a failure, on account of the attack of the radish fly. A planting of seeds from 21 differently-named packages was made July 13 in rows eighteen inches apart, and twelve feet long, one row to each name. The weather was very favorable, the roots made a very rapid growth and were of large size and very crisp and tender.

The following data were noted :

RADISH.	Seeds from	Of edible size.	Days from planting.	A SYNONYM OF
Beckert's Chartier..	Hen.	Aug. 13	31	
Black Turnip.............. (Ger. Sommer-Rettig, runder schwarzer feinlanberger.) (Fr. d'ete noir rond ameliore.)	Ben.	" 16	34	Small Black Summer, Vil.
Blunt pointed demi long White May......	H.& S.	" 16	34	Landreth's White Lady [Finger, Land.
Boston Long Scarlet	Greg.	" 19	37	
Covent Garden............	"	" 16	34	
Earliest Scarlet Erfurt Turnip (Ger. Erfurter Dresenbrunnen runde scharlachrothe Kurzlenbige Treib-Radies.)....	Ben.	" 14	32	
Erfurt Short Top Rose......	H.& S.	" 13	31	Scarlet Turnip, Vil., '84.
Erfurt Short Top Scarlet....	"	" 14	32	Early Deep Scarlet Olive-[Shaped, Vil., '85.
Improved Chartiers........	Thor.	" 13	31	
London Particular Long Scarlet.................	Greg.	" 16	32	
Long White Autumn.......	Dam.	Aug. 19	37	Half Long Strasburg, [Vil., '85.
Long White Naples.	"	" 16	34	Misnomer.
Mammoth Long Rose.......	Foote.	Aug. 14	32	Beckert's Imp'd Chartier's
Oval Yellow May...........	H. & S.	" 16	34	Yellow Summer [Thor.'85
Round Rose Red...........	Dam.	" 13	31	Deep Scarlet. [Thor., '83
Round White Short Leaved.	"	" 16	34	Misnomer.
Short-Top Earliest White Turnip..................	Land.	" 13	31	White Turnip, Vil., '85.
Short-Top Long Scarlet.....	"	" 17	35	
Strap-Leaved Long Scarlet..	"	" 14	32	
Sutton's Rosy Gem.........	J. & S.	" 14	32	Scarlet Turnip White [Tipped.
Violet White Tipped Turnip. (Ger. runde violette mit weissen Knollenende.) (Fr. ronde violet a bout blanc	Ben.	" 13	31	

Synonyms.

The name of the varieties of which the plants appear to be a synonym are given in the right hand column of the table.

ONION.

Seeds of the list of onions given below were planted in the garden April 16, two rows of each twelve feet long, the rows 21 inches apart. The bulbs were thinned out, when they began to crowd, to one inch apart. The different rows were marked "first ripe" when the tops began to fall down.

The weight is computed in ounces for one hundred bulbs from the weight of the whole number of each name.

ONIONS.	Seed from.	First ripe.	Days from planting.	No. of scallions	No. of bulbs.	Wt. in ounces calculated per 100 bulbs
Danver's Yellow	Land.	July 29	104	0	138	177
" " (Cal. seed)	"	" 31	106	0	85	255
Flat Brown Red Tripoli	Dam.	Aug. 16	122	0	71	324
Italian White Flat Mammoth (Fr. de Tripoli blanc plat mammoth) (Ger. Tripoli weisse platte mammoth)	Ben.	July 29	104	0	70	230
Magnum Bonum	Ben.	Aug. 11	118	28	80	266
Mammoth Copper King	J. & S.	July 29	104	3	53	134
Nasbey's Mammoth	Greg.	Aug. 12	118	16	74	358
Pyriforme (Fr. Pyriforme (poire) jaune) (Ger. gelbe suisse Birnzweibel)	Ben.	" 9	115	11	83	249
Silver King	Ev't.	Aug. 7	113	1	42	580
Silver Skin (Cal. seed)	Land.	July 29	104	0	109	178
Silver Skin or White	Land.	Aug. 3	109	0	45	273
Wethersfield red (Cal seed)	"	" 4	110	0	128	227
" " (Conn. seed)	"	" 4	110	0	128	221
White Spanish or Sulphur Yellow (Fr. plat dur jaune sonfie d'espagne) (Ger. schwefelgethe platte runde)	Ben.	" 16	122	56	85	224
Yellow Rocca	Dam.	Aug. 16	122	5	88	553
Yellow Russian (Fr. jaune de Russie)	Vil. '85.	" 9	115	4	237	106

MELON.

The following list of melons were planted May 5 and 6 on inverted sods in the cold frame. June 3 and 4 six of the sods, each containing 3 to 5 plants were set out two feet apart, in rows twelve feet long and seven feet apart. The sods were handled carefully so as not to disturb the roots. The plants did not wilt in the least, and the transplanting did not retard their growth. The varieties received from Maule were planted in the open ground June 8.

The data noted were as follows:

MUSK MELON.	Seeds from.	First bloom.	Days from planting.	First ripe fruit.	Days from planting.
Algiers Cantaloupe	Greg.	June 28	54	Oct. 7	185
All the Year. (Sp. To do del Ano.)	Dpt. Ag.	Aug. 7	94	....	....
Baltimore	Hen.	June 28	54	Sept. 13	161
Bay View	Greg.	“ 24	50	“ 15	163
Bird Canteloupe	“	“ 24	49	Aug. 28	143
“ “	R. N. Y.	“ 23	50	“ 26	145
Black Portugal	Greg.	July 2	58	Oct. 7	187
Boston Pet	“	“ 3	59	Sept. 13	161
Casaba	“	“ 6	62	“ 3	151
Chicago Nutmeg	“	June 26	52	“ 1	149
Early Nutmeg	“	“ 29	55	Aug. 29	146
Golden Netted Gem	“	“ 21	47	“ 30	147
Green Citron	“	“ 23	49	Sept. 6	154
Hackensack	“	“ 26	52	Aug. 26	143
“	Maule.	July 24	46	....	....
“ Valley	R. N. Y.	June 26	52	Sept. 6	154
Hardy Ridge	Greg.	July 3	59	Oct. 7	185
Improved Canteloupe	“	June 24	50	Sept. 4	122
Jenny Lind	“	“ 26	52	Aug. 24	111
Large Boston Nutmeg	“	“ 28	54	“ 28	115
Long Yellow	“	“ 24	50	“ 24	111
Long Persian	Swan.	“ 28	53	Sept. 15	132
Miller's Cream Nutmeg	Greg.	July 3	59	“ 13	130
Montreal Market	Sta.	June 28	53	“ 21	138
Montreal Nutmeg	Greg.	“ 28	53	Aug. 26	113
“ “	Maule.	Aug. 5	64	....	....
Netted Gem	“	“ 5	64	....	....
New White Japan	Greg.	June 26	51	Sept. 6	123
Odcssa	“	July 6	61	“ 4	121
Pine Apple	“	“ 3	58	“ 6	123
Sill's Hybrid	“	June 28	53	“ 6	123
Skillman's Fine Netted	“	“ 26	51	“ 4	121
Spanish Beauty	“	July 9	64	....	....
Surprise	“	June 26	51	“ 4	121
Valentia	“	July 6	61	....	....
Ward's Nectar	“	June 23	48	“ 4	121
WATER MELON.					
New Watermelon	R. N. Y.	July 14	69	“ 15	133
Stoke's Extra Early	J. & S.	“ 14	69	“ 15	133
Volga	Hen.	“ 14	69	“ 15	133

All the varieties ripened fruit except those from Maule. All the Year, *D. of Agr.*, Spanish Beauty, and Valentia, *Greg.*, The Jenny Lind and Long Yellow were earliest, maturing the first fruit August 24.

The latest to mature were Algiers Canteloupe, Black Portugal, and Hardy Ridge, which ripened their first fruit October 7.

Mr. Goff considers the Miller's Cream Nutmeg, *Greg.*, very distinct from any other, it being the first oval, orange-fleshed melon he has met. It is extremely sweet, rich and delicious.

Synonyms.

The Boston Pet, *Greg.*, appeared identical with Christiana, *Sta.*

The Casaba, *Greg.*, and Long Persian, *Swan*, appear to be the same.

The Green Citron, *Greg.*, is the same as Early Nutmeg, *Greg.*

The Large Boston Nutmeg, *Greg.*, Early Nutmeg, *Greg.*, Green Citron, *Greg.*, Hackensack, *Greg.*, and Hackensack Valley, *R. N. Y.*, appear to be identical.

The Montreal Nutmeg, *Greg.*, appears to be a large sub-variety of the Green Citron, *Greg.*, it differs in having a finer net work..

The Pine Apple, *Greg.*, appears to be the same as the Golden Netted Gem, *Greg.*

The Ward's Nectar, *Greg.*, appears to be a large sub-variety of the Golden Netted Gem, *Greg.*

The varieties of watermelon noted in the table were planted in the same manner as the muskmelons, with the exception that the soil was covered with pure sand to the depth of six inches. The vines made a very vigorous growth and matured an excellent crop.

CUCUMBER.

The varieties of the cucumber were planted in the same manner as the melon, with the exception of those received from Maule, which were planted in the west garden June 7.

The data noted were as follows :

CUCUMBER.	Seeds from.	First bloom.	Of pickle size	First ripe fruit.
Bismark	Greg.	June 21	July 16	Aug. 9
Borowskian	H. & S.	“ 21	“ 8	“ 2
Boston Pickling	Greg.	“ 21	“ 8	“ 4
Early Cluster	“	“ 24	“ 9	“ 4
Early Frame	Maule.	Aug. 1	Aug. 5	....
“ “	Greg.	June 28	July 10	Aug. 7
Early Green Cluster	Maule.	Aug. 2	Aug. 6	....
Early Russian	Greg.	July 19	July 6	July 31
Early White Spine	Maule.	Aug. 3	Aug. 7	....
Evergreen White Spine	J. & S.	June 23	July 8	Aug. 4
Extra Long Smooth	Greg.	“ 23	“ 7	“ 6
Extra Long White Spine	Maule.	Aug. 3	Aug. 7	....
Green Italian Serpent	Dam.	June 28	July 22	Sept. 3
Green Prolific	Maule.	July 26	Aug. 2	....
Green Prolific Pickling	Greg.	June 21	July 6	July 29
Improved Long Green	Maule.	Aug. 3	Aug. 10	....
Improved Long Green Pickling	Greg.	June 23	July 8	Aug. 2
Improved White Spine	Maule.	Aug. 3	Aug. 10	....
Improved White Spined	Greg.	June 24	July 8	Sept. 4
Khiva Netted	Ben.	“ 21	“ 8	Aug. 4
Large White Bonneuil	Greg.	July 1	“ 12	“ 21
Long Green	“	June 23	“ 9	“ 9
Long Green Serpent	Dam.	“ 23	“ 10	“ 23
Long Green Smooth from Athens	Greg.	“ 28	“ 9	“ 5
Muromian	H. & S.	“ 17	“ 5	“ 23
New Long Grecian	Maule.	Aug. 3	Ang. 11	....
Nichol's Medium Green	Hen.	June 26	July 8	Aug. 5
Peerless White Spine	Maule.	Aug. 3	Aug. 9	....
“ “ “	Greg.	June 26	July 11	Sept. 5
Russian Netted	“	“ 23	“ 10	July 28
“ “	Ben.	“ 21	“ 9	“ 23
Russian Netted Cluster	H. & S.	“ 21	“ 10	“ 23
Russian Shortest Green	Ben.	“ 18	“ 5	“ 23
Russian Small Earliest Pickling	H. & S.	“ 21	“ 5	“ 27
Short French Pickling	Greg.	“ 21	“ 13	“ 9
Short Green	Maule.	July 24	Aug. 3	....
“ “	Greg.	“ 5	July 24	Aug. 11
Short Pickling	“	June 28	“ 14	“ 9
Tailby's Hybrid	“	July 3	“ 16	“ 9
White German	“	“ 5	“ 24	“ 19

The varieties were noted “of pickle size” when the first fruits were about three inches in length. It appears that the Muromian, *H. & S.*, Russian Shortest Green, *Ben.*, and Russian Small Earliest Pickling, *H. & S.*, attained this size earliest.

Synonyms.

The Borowskian, *H, &. S.*, Boston Pickling, Early Russian, *Greg.*, Muromian, *H. & S.*, Russian Shortest Green, *Ben.*, Russian Small Earliest Pickling, *H. & S.*, appear to be the same as the Small Early Russian, *Vil.*, '84.

The Russian Netted Cluster, *H. & S.*, appears to be the same as Russian Netted, *Ben.* and *Greg.*

SQUASH.

The seeds of the following list of squashes were planted May 15 and 17, with the exception of the Improved Hubbard and Marblehead, *Maule.*, which were planted June 17.

Two hills of each of the running varieties were planted twelve feet apart, in rows ten and one-half feet apart. Four hills of each of the bush varieties were planted four feet apart and the rows seven feet apart. The hills were prepared by removing the soil to the depth of twelve inches; about six inches of well rotted compost was then put in and covered with six inches of earth. Four plants were allowed to grow in each hill. The vines made a very rampant growth.

In the table the "edible size" was noted the same as last season, when the first fruit was four inches in diameter.

SQUASH.	Seeds from.	First bloom.	Days from planting.	Of edible size	Days from planting.
Cocoanut	Greg.	July 15	61	Aug. 7	84
Hubbard	“	“ 9	55	July 29	75
Improved Hubbard	Maule.	Aug. 2	56	Aug. 10	74
Long Green Crookneck	J. & S.	July 15	61	“ 9	86
Long White Italian Mushroom	Dam.	“ 12	58	“ 2	79
Marblehead	Greg.	“ 9	55	“ 4	81
Marblehead	Maule.	Aug. 3	57	“ 14	78
Neapolitan Portmanteau	Dam.	July 19	65	“ 12	89
New Mediterranean	J. & S.	“ 10	56	“ 12	89
Olive	Greg.	“ 21	67	“ 3	80
Orange Colored Giant Melon	Dam.	“ 21	67	“ 9	86
Red Cardinal	“	“ 9	55	“ 1	74
BUSH SQUASH.					
Citron Bush	Dam.	July 3	49	July 15	61
Early	“	“ 12	56	Aug. 9	84
Early Bush	Greg.	“ 6	50	July 17	61
Long White Marrow	H. & S.	“ 5	49	“ 16	60
Long White Marrow Bush	J. & S.	“ 6	50	“ 16	60
Mandarin Bush	Dam.	“ 3	47	“ 17	61
Narrow Striped Cluster	H. & S.	“ 3	47	Aug. 3	78
Orange Bush	Dam.	“ 9	53	July 17	61
Summer Crookneck	Greg.	“ 6	50	“ 24	69
White Portmanteau	Dam.	“ 6	50	Aug. 20	95

PUMPKIN.

The data noted were as follows :

PUMPKIN.	Seeds from.	First bloom.	Days from planting.	First fruits ripe.	Days from planting
Large Cheese	Hen.	July 16	60	Sept. 14	120
Mammoth Red Etampes	Greg.	" 19	63	" 13	119
Possum Nose	"	" 24	68	" 10	116
Tree	"	" 24	68	" 9	115
No. 1 Oblong	Pow.	" 9	53	" 9	115
No. 2 Shape of Perfect Gem Squash	"	" 9	53	" 9	115

CELERY.

Seeds from the following list of celeries were planted May 6 in boxes in the cold frame, and July 10 thirty plants of each were transplanted in trenches prepared as follows: Trenches 3 1-2 feet apart were dug eighteen inches wide and fifteen inches deep. Some of the soil taken from the trenches and well rotted compost were thoroughly mixed and filled into the trench to the depth of six inches ; three inches of soil was placed upon this, leaving the trench six inches deep. The plants were set in the trenches about six inches apart. The plants were rather small when set, and in several of the trenches many were destroyed by the heavy rains washing the soil in upon them. The soil was banked up around the plants, with the exception of Henderson's White Plume, twice during the season, the last time about the 20th of September.

The average length of the blanched stems, and the weight, calculated on the basis of one dozen plants, were as noted on next page.

CELERY.	Seeds from.	Av. length of blanched stalks in inches.	Weight in ounces per 12 plants.
Boston Market	Land.	9	276
Cole's Solid Red	H. & S.	13	261
Cole's Solid White	“	12	174
Crawford's	Greg.	9	144
Curled	H. & S.	9	128
Dwarf Golden Heart	Greg.	9	132
Early Arlington	“	10	180
Eureka Self-Blanching	Ev't.	7	156
Fern-Leaved (Carter's)	H. & S.	7	101
Fern-Leaved	Dam.	8	480
Golden Dwarf	Land.	9	216
Golden Self-Blanching	Burpee.	5	227
Half Dwarf	Land.	9	180
Henderson's White Plume	Greg.	7	214
La Plume Chestnut	Greg.	9	178
Large White Solid	Land.	10	147
Leicester Red	Dam.	9	234
Major Clark's Pink	Hen.	13	179
“ “ “	J. & S.	10	204
Perfection Heartwell	Greg.	9	273
Red or Pink	Land.	12	210
Sandringham Dwarf	Greg.	9	174
“ Dwarf White	Land.	12	208
Solid Ivory	Greg.	7	150
Turner's Incomparable	“	11	153
White Curled Giant of Naples	Dam.	9	240
White Italian	“	9	206
White Solid	Greg.	12	234

The foliage of the Red or Pink, *Land.*, was somewhat blighted, but all the other varieties appeared free from blight. The red varieties seem generally less liable to blight.

Cole's Solid Red, *H. & S.*, averaged the greatest length of blanched stalks, and Fern Leaved, *Dam.*, the greatest weight per dozen plants.

The Fern Leaved appears to be of very little value. The stalks are very small, although very numerous. They were tough and very stringy, and the quality poor. The leaves are finely cut and appear very different from other varieties.

The White Italian has leaves very similar to the Fern Leaved.

Curled, *Dam.*, has very beautiful curled leaves which make a very handsome appearance, the stalks were small and somewhat stringy, fair flavor.

The foliage of Fern Leaved (Carter's), *H. & S.*, differs from Fern Leaved, *Dam.*, in having the leaves slightly curled.

EGG PLANT.

Seeds from the following list of egg plants were planted in boxes in the greenhouse March 20, and transplanted in the garden June 2, in rows twelve feet long and 3 1-2 feet apart. The plants were eighteen inches apart in the row. They were protected from the ravages of the potato bug by occasional applications of Paris green and gypsum, the same as used for potatoes. The plants made a vigorous growth.

The "first edible maturity" was noted when the first fruit was three inches in diameter.

The following data were noted:

EGG PLANT.	Seeds from.	First bloom.	Days from planting.	First edible maturity.	Days from planting.
Black Pekin	Greg.	Aug. 3	136	Aug. 27	160
"	Thor.	July 25	127	" 25	158
Early Long Purple	Greg.	" 20	122	" 25	158
Early Round Violet	Dam.	June 26	98	July 27	129
Extra Early Dwarf Purple	Thor.	" 28	100	" 30	132
Giant Violet	Dam.	July 26	128	Sept. 18	182
Large Scarlet Red	"	" 26	128	" 15	179
Long Black Purple of Palermo. (Ger. Lange Schwarzviolette von Palermo	Ben.	" 23	125	" 6	170
Long Dark Violet of Palermo	Dam.	" 24	126	Aug. 27	160
Long Purple	Thor.	" 19	121	" 30	163
Monstrous of New York	Dam.	" 10	112	Sept. 13	177
N. Y. Improved Large Round Purple.	Greg.	Aug. 4	137	Aug. 27	160
New York Purple	Thor.	July 27	129	" 28	161
Round Purple	"	" 10	112	" 6	139
Round White	"	......	......	......	....
Scarlet	Greg.	" 24	126	Sept. 11	175
Scarlet Chinese (Solanum coccineum).	Thor.	" 26	128	" 15	179
Striped ornamental.	"	" 26	128	Aug. 28	161
Very Early Dwarf Purple	Greg.	" 1	103	" 5	138
White	Thor.	" 9	111	" 30	163
White Giant of Naples	Dam.	" 26	128	" 30	163

Synonyms.

The Extra Early Dwarf Purple, *Thor.*, Early Round Violet, *Dam.*, and Very Early Dwarf Purple, *Greg.*, appeared to be the same.

The Long Black Purple of Palermo, *Ben.*, and Long Dark Violet of Palermo, *Dam.*, are evidently the same.

The White, *Thor.*, and White Giant of Naples, *Dam.*, appear to be identical.

Mr. Goff thinks the Scarlet, *Greg.*, '86, is the same as the Tomato Shaped Red, *Bliss*, '83.

Also that the Large Scarlet Red, *Dam*, '86, and the Scarlet Fruited, *Bliss*, '83, are identical.

PEPPERS.

Seeds of the following list of peppers were planted in boxes in the greenhouse March 20- The plants were potted in three inch pots May 25, and eleven plants of each, with a few exceptions, were transplanted in the garden June 1. The rows of the larger growing varieties were three and a half feet apart, of the others twenty-one inches, and the plants were set one foot apart in the row.

The data noted appear on opposite page.

PEPPERS.	Seed from.	First bloom.	Days from planting.	First fruit ripe.	Days from planting.
Bell	Greg.	July 3	105	Sept. 2	166
Bell or Bull Nose	Sib.	" 19	121	" 15	179
Bull Nose	Land.	" 6	108	" 1	165
Buttercup	Ev't.	" 3	105	Aug. 23	156
Cayenne, (Ger. Pfeffer spanischer langer rother von Cayenne	Ben.	" 2	104	" 11	144
Cayenne	Ev't.	June 24	96	" 24	157
"	Greg.	July 3	105	" 31	164
"	Land.	June 24	94	" 12	145
"	Sib.	July 10	112	" 17	150
Cherry	Greg.	" 10	112	" 11	144
"	Thor.	June 23	95	" 26	159
Cherry Red	Hen.	July 2	104	" 26	159
Cherry Yellow, (Ger. Pfeffer, spanischer kirsch formiger gelber; (Fr. Pimento cerise jaune)	Ben.	" 1	103	" 12	145
Cherry (Fr. Cerise)	Vil. '85.	" 10	112	Sept. 6	170
Chili	Greg.	" 3	105	Aug. 23	156
"	Hen.	June 24	96	" 16	149
Chili (Fr. du Chili)	Vil. '85.	" 23	95	" 11	144
Chili Round Red	Land.	" 23	95	" 16	149
Cranberry	Hen.	" 23	95	" 16	149
Giant Emperor	"	July 6	108	Sept. 2	166
Golden Bell	Land.	" 6	108	" 1	165
Golden Dawn	Hen.	" 3	105	Aug. 18	151
" "	Sib.	June 28	100	" 18	151
Golden Dawn Mango	Greg.	" 23	95	" 14	147
Large Bell or Bull Nose	Ev't.	July 7	109	Sept. 10	174
" " " " "	Hen.	" 20	122	" 22	186
Large Bell	Thor.	" 6	108	Aug. 26	159
Large Cheese	J. & S.	" 10	112	Sept. 13	177
Large Squash	Thor.	" 6	108	" 13	177
Large Sweet Spanish	Ev't.	" 12	114	" 17	181
Long Cayenne	Thor.	" 2	104	Aug. 16	149
Long Red Cayenne	Hen.	June 28	100	" 18	151
" " "	Sib.	July 20	122	Sept. 16	180
Long Red (Fr. rouge long ordinaire)	Vil. '85.	" 10	112	" 13	177
Long Yellow Cayenne	Hen.	" 3	105	Aug. 24	157
" " "	Thor.	" 6	108	Sept. 3	167
Long Yellow	Greg.	" 6	108	" 6	170
" "	Sib.	" 9	111	" 3	167
" " (Fr. jaune long)	Vil. '85.	" 12	114	" 13	177
Maddaloni	Dam.	" 20	122	" 16	180
Mild Galveston	"	" 10	112	" 4	168
Mild Red of Palermo	"	" 21	123	" 13	177
Mild Scarlet Maddaloni (Ger. Pfeffer, spanischer Maddaloni milder scharlach rotter)	Ben.	" 12	114	" 13	177
Mild Yellow Nocera. (Ger. Pfeffer, spanischer Nocera milder gelber monstroser	Ben.	" 12	114	Sept. 16	180
Monstrous. (Ger. Monstreux)	Vil. '85.	" 12	114	" 18	182
Monstrous or Grossum	Ev't.	" 12	123	" 21	185

PEPPERS.	Seed from.	First bloom.	Days from planting.	First fruit ripe.	Days from planting.
Monstrous Red Giant	H. & S.	July 6	108	Sept. 3	167
New Cranberry	Sib.	" 6	108	Aug. 26	159
New Cranberry	Thor.	" 3	105	" 26	159
New Golden Queen	J. & S.	" 9	111	Sept. 13	177
New Oxheart	Thor.	" 6	108	Aug. 26	159
New Spanish Sweet—" Pimento Dulce "	Hen.	June 29	101	Oct. 1	195
Oxheart	Hen.	June 29	101	Aug. 26	159
Prince of Wales	H. & S.	July 10	112	" 9	142
Red Cherry	Sib.	" 3	105	" 26	159
Red Chili	"	June 23	95	" 18	151
Red Prince	Ev't.	July 3	105	Sept. 1	165
Ruby King	Sib.	" 9	111	" 15	179
Santa Fe	Greg.	" 19	121	" 20	184
Small Chili	Thor.	" 10	112	" 14	178
Spanish Monstrous	Greg.	" 21	123	" 19	183
Squash	"	" 20	122	" 18	182
Squash or Tomato Shaped	Hen.	" 6	108	" 13	177
" " "	Land.	" 6	108	Aug. 25	158
" " "	Sib.	" 17	119	Sept. 13	177
Sweet Golden Dawn	Thor.	" 19	121	" 2	167
Sweet Mountain	Greg.	" 10	112	" 15	179
Sweet Mountain or Mammoth	Hen.	" 9	111	" 3	168
Sweet Mountain	Sib.	" 10	112	" 29	193
" "	Thor.	" 6	108	" 6	171
Sweet Spanish	Hen.	" 17	119	" 11	176
" "	Sib.	" 19	121	" 20	184
" "	Thor.	" 10	112	" 7	172
" "	Vil. '85.	" 20	122	" 8	173
Yellow Chili	Thor.	June 28	100	Aug. 26	159
Yellow Squash or Tomato Shaped. (Ger. Pfeffer, spanischer liebesfuch-tiger gelber). (Fr. Piment—tomate jaune)	Ben.	July 10	112	Sept. 14	179

The following are synonyms as determined by Mr. Goff :

Buttercup, *Ev't*, Golden Bell, *Land.*, Sweet Golden Dawn, *Thor.*, and the Golden Dawn Mango, *Greg.*, were the same as the Golden Dawn, *Hen. & Sib.*

Large Sweet Spanish, *Ev't*, Red Prince, *Ev't.* appear to be the same as Sweet Spanish, *Vil.*, '85.

Long Red Cayenne, *Hen.*, same as Cayenne, *Ben.*, *Greg. & Ev't.*

Mild Scarlet Maddaloni, *Ben.*, probably the same as Maddaloni, *Dam.*

New Cranberry, *Sib.*. and *Thor.*, same as Cranberry, *Hen.*

New Golden Queen, *J. & S.*, probably the same as Orange Bell, grown in 1883, *State Fair*, '82.

New Oxheart, *Thor.*, same as Oxheart, *Hen.*

TOMATOES—A TEST OF VARIETIES.

The plantings of seed of the following list of tomatoes were made in boxes in the greenhouse. The first planting was Mar. 4, and included seeds from all packages received to that time.

A number of packages of seed were received afterwards, and a second planting was made March 20, and included all those of the first planting. Four plants from the seed of each package were transplanted in the garden May 20, in rows seven feet apart and three feet apart in the rows. The dates of the first ripe fruit, and the first ten ripe fruits of each, are given in the following table :

TOMATO.	Seeds from.	First bloom.	Days from planting.	First fruit ripe.	Days from planting.	Ten fruits ripe.	Days from planting.
Arlington	Sta.	June 15	87	Aug. 14	147	Aug. 28	161
Autocrat	Sib.	“ 16	104	“ 20	169	“ 30	179
Blount's Champion Cluster	Thor. '80	“ 16	104	“ 31	180	Sept. 6	186
Boston Market	Sta.	July 26	128	“ 31	164	“ 3	167
Bronze Foliage Trophy	Thor.	June 14	102	“ 27	176	“ 2	182
Burpee's Cardinal	Burpee.	“ 17	89	“ 23	156	“ 3	167
“ Climax	“	“ 16	88	“ 14	149	Aug. 31	164
Canada Victor (Extra Selected Seed)	Greg.	“ 14	102	“ 6	155	“ 14	163
Canada Victor	“	“ 14	102	“ 6	155	“ 12	161
Cardinal	Sta.	July 16	118	Sept. 3	167	Sept. 8	172
Caster's Green Gage	Ben.	June 15	103	Aug. 2	151	Aug. 10	159
Dwarf Striped Japanese (Ger. Japanische neidrige geistreifte. (Fr. du Japan naine Strieé)	“	“ 15	103	“ 6	154	“ 14	163
Early Acme	Liv.	“ 21	109	“ 27	176	“ 30	179
Early Richmond	Land.	“ 15	103	“ 11	159	“ 24	173
“ “	Sta.	July 15	117	“ 14	147	“ 18	151
Early York	“	“ 15	117	“ 9	142	“ 14	147
Emery	“	“ 17	119	“ 16	149	“ 24	157
Essex Round Red Smooth	“	June 18	90	“ 30	163	Sept. 1	165
Extra Early Trophy	J. & S.	“ 15	103	“ 7	155	Aug. 11	160
Favorite	Sta.	“ 17	89	“ 14	147	“ 31	164
Fulton Market	“	July 16	118	“ 30	163	Sept. 2	166
Giant of Smyrna	Dam.	June 16	88	“ 18	151	Aug. 27	160
Golden Queen	Liv.	July 5	122	Sept. 6	186	Sept. 13	193
Golden Trophy	Sta.	June 15	87	Aug. 17	150	Aug. 30	194
Gooseberry Fruited.	H. & S.	“ 28	116	Sept. 3	183	Sept. 7	187
Greneir (with erect stem). (Ger. Greneir a tigé raide de Laye.) (Fr. Rouge á tige raide de Laye	Ben.	Ang. 14	147	......	....	....	....
Hathaway's Excelsior	Sta.	June 16	88	Aug. 12	145	Aug. 30	163
Horsford's Prelude	Hors.	“ 16	104	“ 12	161	“ 17	166

TOMATO.	Seed from.	First bloom.	Days from planting.	First fruit ripe.	Days from planting.	Ten fruits ripe.	Days from planting.
Howard.................	Sta.	July 16	118	Aug. 16	149	Aug. 26	159
Hubbard's Curled Leaf...	“	“ 15	117	“ 10	143	“ 14	147
Improved Queen.........	Thor.	“ 3	121	“ 28	177	“ 31	180
Livingston's Beauty......	Liv.	“ 3	121	“ 26	175	Sept. 3	185
Livingston's Favorite.....	“	“ 16	134	“ 26	175	“ 3	185
Macrophylum....	Dam.	June 16	88	“ 18	151	Aug. 25	158
Market Champion..... ..	J. & S.	“ 16	104	“ 25	174	Sept. 6	186
Mayflower.	Sta.	“ 16	88	“ 13	146	Aug. 30	163
Mikado	Hen.	“ 16	104	“ 23	172	Sept. 2	182
New Red Apple.........	Sta.	“ 17	89	Sept. 3	167	Sept. 7	171
New York Market........	“	“ 16	88	Aug. 12	145	“ 1	165
Optimus	“	“ 16	88	“ 23	156	Aug. 30	163
Paragon.................	Hen., '83	“ 16	104	Sept. 3	183	Sept. 7	187
Paragon.....	Liv.	July 3	105	“ 1	165	“ 6	170
Perfect Gem............	Ang.	“ 15	117	Aug. 11	144	Aug. 15	148
Potato Leaf............	Liv.	June 7	?	“ 30	!	Sept. 3	?
Precursor...............	Sta.	July 16	118	“ 15	148	Aug. 26	159
Precursor...............	Maule.	July 15	117	Aug. 15	148	Aug. 24	157
Queen	Sta.	“ 16	118	“ 23	155	Sept. 1	166
Reade's Island Beauty..	“	June 16	118	Aug. 10	143	Aug. 14	147
Red Valentia Cluster.....	“	“ 28	130	Sept. 1	166	Sept. 7	172
Rose Fruited Giant......	Ben.	“ 15	133	Aug. 14	163	Aug. 23	172
San Salvador.......... .	Dam.	July 15	117	“ 6	139	Aug. 8	141
Santa Catarina...........	H. & S.	“ 16	134	“ 24	174	Sept. 4	184
Tilden's New............	Sta.	June 18	120	“ 29	162	“ 1	166
Triumph	“	“ 15	117	“ 9	142	Aug. 12	145
Trophy	Hen., '83	July 16	134	“ 21	171	“ 27	177
Wonder of Italy	Dam.	“ 16	118	“ 17	150	“ 24	157
Yellow Victor...........	Sta.	June 19	121	Aug. 21	154	“ 23	156

Carter's Green Gage, *Ben.*, ripened the first fruits at the earliest date but not in the least number of days from planting; the fruits of this variety are small and of but little value except for pickling.

San Salvador, *Dam.*, ripened first fruit and also the first ten fruits in the shortest time from planting, which were 139 and 141 days respectively. The fruit of this variety appears to be of no value in this country.

Seeds of Canada Victor (extra selected seed), *Greg.*, and Canada Victor, *Greg.*, were planted and there appeared to be no difference in the fruit of the two plantings either in earliness or other qualities.

Two plants of the Potato Leaf were received June 7 from A. W. Livingston's Sons. Not knowing when the seeds were planted, the number of days in the table could not be filled in correctly. The fruits were much smoother and not as large as the Mikado, *Hen.*

Synonyms.

Burpee's Cardinal, *Burpee*, does not appear different from Cardinal, *Greg.*, '85.

Carter's Green Gage, *Ben.*, is the same as Green Gage, *Thor.*, '83.

The Wonder of Italy, *Dam.*, does not differ from King Humbert, *Thor.*, '85.

PEA.

Seeds from twenty-six differently named packages of peas were planted April 16. Four packages that were numbered came in later and were planted April 19 and 20. One row twelve feet long was planted from each package, the seeds placed three inches apart, the rows seven feet apart. The rows were bushed as soon as the plants began to send out tendrils.

The "days fit for table use" in the table indicates the days between the time when the earliest and latest pods were of edible size.

The data noted appear on next page.

PEA.	Seeds from	First bloom.	Days from planting.	Pods of edible size.	Days from planting.	Days fit for table use.	First seeds ripe	Days from planting.	Last seeds ripe	Days from planting.	No. of pods per 100 plants.	No. of peas in 100 av. pods.
Alaska	Cleve.	May 24	38	June 11	56	14	June 26	71	July 7	82	394	554
Alaska	R. N. Y	" 25	39	" 11	56	14	" 26	71	" 7	82	513	513
Burpee's Extra Early	Burpee	" 26	40	" 11	56	14	" 26	71	" 7	82	697	504
Cleveland's Rural New Yorker	Cleve.	" 25	39	" 11	56	14	" 26	71	" 7	82	444	628
Dreer's Eureka Extra Early	Dreer.	" 25	39	" 11	56	14	" 26	71	" 7	82	940	635
Erfurt Dwarf. Green Marrow	H. & S.	June 26	71	July 6	81	17	July 30	105	Aug. 4	110	1884	435
Erfurt Early Dwarf White Marrow	"	" 7	52	June 23	68	19	" 9	84	July 23	98	2235	456
Erfurt May Earliest	"	May 29	43	" 15	60	18	" 1	76	" 7	82	681	556
Erfurt 2d Earliest	"	June 9	54	" 28	73	18	" 12	87	" 28	103	1163	475
Extra Early	J. & S.	May 26	40	" 11	56	14	June 26	71	" 7	82	465	587
French Canner	Land.	" 29	43	" 18	63	13	July 1	76	" 7	82	607	561
Garden Pride	J. & S.	" 28	42	" 14	59	14	June 28	73	" 9	84	582	446
Glory of Cassel	H. & S.	June 7	52	" 23	68	15	July 6	81	" 20	95	636	561
Green Sword, Sabre or Beak	"	" 7	52	" 24	69	15	" 9	84	" 16	91	694	520
Landreths Extra Early	Land.	May 25	39	" 11	56	14	June 26	71	" 7	82	545	629
Laxton's Marvel	Sta.	June 11	56	" 26	71	14	July 12	87	" 16	91	440	666
Livingston's 1st in Market	Liv.	May 26	40	" 11	56	14	June 26	71	" 7	82	368	593
Maule's Earliest of All	Maule.	" 25	39	" 11	56	17	" 28	73	" 7	82	840	635
Philadelphia Extra Early	Land.	" 20	40	" 11	56	14	" 26	71	" 7	82	460	601
Prince Bismarck	H. & S.	" 29	43	" 15	60	18	" 28	73	" 7	82	795	570
Sabre or Beak	"	June 4	49	" 19	64	19	July 6	81	" 16	91	1139	697
Small Early French	Thor.	May 29	43	" 16	61	20	" 3	78	" 11	86	735	464
Sutton's Early Gem	H. & S.	" 26	40	" 11	56	14	June 26	71	" 7	82	776	506
Tall Buttter Sugar	Greg.	June 1	46	" 19	64	14	July 8	83	" 21	96	4093	543
Walker's Perpetual Bearing	"	" 21	50	July 8	83	15	" 21	96	" 23	98	4030	583
White Brunswick	H. & S.	" 7	52	June 24	61	12	" 5	80	" 10	85	621	596
No. 1	Vick.	" 1	42	" 15	56	14	" 3	74	" 9	80	561	614
No. 2	"	" 1	42	" 15	56	14	" 3	74	" 9	80	361	628
No. 3	"	May 31	41	" 16	57	14	" 5	76	" 9	80	495	531
No. 38	Greg.	June 10	52	" 26	68	20	" 14	86	" 24	96	4513	278

It appears that thirteen rows produced pods of edible size in fifty-six days from planting. In eleven rows the pods were of edible size on the same day, June 11. In sixteen rows peas were fit for table use fourteen days.

Erfurt Early Dwarf White Marrow, *H. & S.*, yielded the greatest number of pods calculated per hundred plants.

Sabre or Beak, *H. & S.*, produced the greatest number of peas per hundred pods.

Synonyms.

The following so called varieties, Alaska, *Cleve.*, and *R. N. Y.;* Burpee's Extra Early, *Burpee;* Cleveland's Rural New Yorker, *Cleve.;* Dreer's Eureka Extra Early, *Dreer;* Extra Early, *J. & S.*; Landreth's Extra Early, *Land.;* Livingston's 1st in Market, *Liv.*; Maule's Earliest of All, *Maule*, so closely resemble the Philadelphia Extra Early, *Land.*, both in habit of growth and also in earliness that I can perceive no reason for calling them different varieties.

OKRA.

Seeds of the following differently named samples of okra were planted in the garden May 29 in rows three and a half feet apart, the plants were thinned out to eighteen inches in the row. The plants are very difficult to grow in the greenhouse on account of their liability to "damp off," but there was no difficulty in growing them in the open ground this season after the soil had become warm and weather settled.

The data noted were as follows:

OKRA.	Seed from.	First bloom.	Days from planting.	Of edible size.	Days from planting.
Dwarf	Land.	July 29	61	Aug. 10	73
Gombo of Egypt	Dam.	" 28	60	" 7	70
Landreth's Long Green Pod	Land.	" 28	60	" 5	68
" Long White	"	Aug. 1	63	" 28	91
Sultan of Smyrna	Dam.	" 18	81	Sept. 11	105
Velvet (M. W. Johnson & Co.)	....	July 28	60	Aug. 13	76

Synonyms.

The following varieties Mr. Goff considers as probably synonyms:

Gombo of Egypt, *Dam.*, appears to be a mixture of the two varieties, Dwarf, *Land.*, and Louisiana Gumbo, *Thor.*, '85.

Landreth's Long White, *Land.*, is the same as Louisiana Gumbo, *Thor.*, '85.

Sultan of Smyrna, *Dam.*, appears to be a very dwarf sub-variety of the Louisiana Gumbo, *Thor.*, '85.

BEANS.

The following list of beans were planted in the garden May 15, with the exception of eleven packages received from Maule which were planted June 8. The seeds of the bush varieties were planted in rows twelve feet long and three and a half feet apart, the seeds were placed three inches apart in the row. The climbing varieties were planted in hills three feet apart in the row, and a pole was placed at each hill to support the vines. Six of the varieties besides the Lima beans failed to ripen all the pods. The Large Lima, *Maule*, did not ripen any pods.

The data noted appear on opposite page.

BUSH BEANS.	Seed from.	First bloom.	Days from planting.	Of edible size.	Days from planting.	First seed ripe.	Days from planting.	Last seed ripe.	Days from planting.	No. of pods per 100 plants.	No. of beans per 100 pods.
Canadian Wonder	Maule.	July 29	51	Aug. 2	55	Sept. 25	109	......	......	2889	415
Cleveland's Improved Valentine	Cleve.	" 1	47	July 12	58	Aug. 13	90	Aug. 30	107	2972	428
First of All	Maule.	" 19	41	Aug. 2	55	" 23	81	Sept. 22	106	1123	415
French Etampes or English Canterbury	Hen.	June 23	39	July 10	56	July 29	75	Aug. 30	107	1930	403
Garden Beans	Tay.	" 20	36	" 15	61	Aug. 31	108	......	......	410	168
Golden Wax	Maule.	July 17	41	Aug. 4	57	" 30	83	Sept. 13	87	323	280
Henderson's Earliest Red Valentine	Hen.	" 2	48	July 16	62	" 14	91	Aug. 30	107	3195	418
Improved Tree	Maule.	Aug. 30	83	Sept. 9	93	Sept. 15	99	......	......	3040	482
Improved Valentine	"	July 25	47	Aug. 9	62	" 11	85	Sept. 27	111	1004	393
Ivory Pod	"	Aug. 3	56	" 16	69	" 14	98	" 28	112	1054	470
Landreth's 1st in Market	Land.	June 24	40	" 10	56	July 28	74	Aug. 27	104	....	430
Lemon Pod	Maule.	Aug. 3	56	" 25	78	Sept. 28	112	Oct. 9	123	1650	239
Lows Champion	Greg.	June 26	42	July 12	58	Aug. 12	89	Aug. 30	107	1140	426
" "	Thor.	" 26	42	" 12	58	" 12	89	" 30	107	1789	428
Marblehead Early Dwarf Horticultural	Greg.	" 25	41	" 12	58	" 6	83	" 30	107	2117	474
New Golden Refugee	Maule.	Aug. 14	67	Aug. 27	80	Sept. 21	105	......	......	2760	461
Rhode Island Dwarf Caseknife	Hen.	June 23	39	July 10	56	July 30	76	Aug. 25	102	1700	408
Rhode Island White	Greg.	" 23	39	" 10	56	" 30	76	" 25	102	1308	417
Selected Black Wax	Maule.	July 19	41	Aug. 4	57	Sept. 3	77	Sept. 27	111	523	415
Spotted Wax	H. & S.	June 29	45	July 14	60	Aug. 12	89	Aug. 31	108	3411	280
Warren	Greg.	" 26	42	" 12	58	" 10	87	" 31	108	1571	349
Wonder of France	"	July 1	47	" 14	60	" 16	93	Sept. 6	114	4100	320
POLE BEANS.											
Curious	Greg.	July 3	49	July 23	76	Aug. 23	100	Sept. 6	114	4250	265
Essex Prolific	"	" 8	54	" 28	81	" 28	105	Oct. 11	149	6767	367
Golden Butter Wax	H. & S.	" 3	49	" 19	65	" 16	93	" 11	149	3661	448
Improved Dutch Runner	Maule.	" 12	34	Aug. 11	64	Sept. 10	94	......	......	4117	321
Kidney Cranberry	Batch.	" 23	69	July 28	81	Aug. 28	105	......	......	2136	395
Southern Prolific	Greg.	" 9	55	Aug. 3	80	" 25	102	Sept. 14	122	8129	660
LIMA BEANS.											
Jersey Extra Early	Hen.	July 8	54	Aug. 25	102	Sept. 13	121	......	......	6012	251
King of the Garden	Greg.	" 9	55	" 25	102	" 6	114	......	......	5260	316
" " " "	J. & S.	" 27	73	" 25	102	" 10	118	......	......	3845	285
Large Lima	Maule.	Aug. 20	73	Sept. 8	92	......	......	......	......	....	.....
New Early	Thor.	July 8	54	Aug. 27	104	Sept. 6	114	......	......	6080	233

The Spotted Wax, *H. & S.*, produced the greatest number of pods calculated per hundred plants, and Marblehead Early Dwarf Horticultural, *Greg.*, the greatest number of beans per pod of any of the bush varieties.

The Southern Prolific, *Greg.*, was the most prolific pole bean.

Synonyms.

Rhode Island Dwarf Case Knife, *Hen.*, and Rhode Island White, *Greg.*, appear to be identical.

ALKAKENGI.

In the following list of Alkakengi or Strawberry tomato, the seeds of the first three names in the table were planted in boxes in the greenhouse March 20 and transplanted in the garden June 3. The others were planted May 10 and transplanted in the garden June 24.

The data noted were as follows:

ALKAKENGI.	Seeds from.	First bloom.	Days from planting.	First fruit ripe.	Days from planting.
Strawberry Tomato	Farq.	June 14	86	Aug. 14	147
" "	Hen.	" 12	84	" 12	145
Philadelphacum physalis	Sta.	May 10	51	Sept. 6	170
Petite de Tomate de Mexique	Vil.	Aug. 12	53	....	....
Du Perou	"	" 18	59	....	....

HERBS.

In the following table the data noted during three consecutive years are given in order that the relative time of first bloom and ripe seeds for the different years can be estimated.

HERBS.	Year planted.	1886.		1885.		1884.	
		First bloom.	First ripe seeds.	First bloom.	First ripe seeds.	First bloom.	First ripe seed.
Balm	1883	July 6	Aug. 14	———	———	July 5	———
Borage	1886	June 18	July 20	June 26	Aug. 8	———	———
Burnet	1884	May 18	June 28	May 28	July 28	———	———
Caraway	1884	" 15	" 26	June 1	" 31	May 17	June 24
Catnip	1885	June 29	Aug. 10	July 3	Aug. 8	———	———
Chervil—common (Fr. Cerfeuil commun	1885	———	June 28	June 20	July 30	———	———
Chervil—curled (Fr. Cerfeuil frisé)	1885	———	June 28	June 20	" 27	———	———
Cumin	1886	June 30	———	———	———	———	———
Dill	1886	July 5	July 29	July 6	Aug. 1	———	———
Dyer's Madder	1886	June 19	Sept. 22	———	———	———	———
Fennel—bitter	1884	" 28	July 30	June 30	Aug. 7	———	———
Fenugreek	1886	" 28	Aug. 12	" 17	" 18	———	———
Gobo	1883	July 15	" 27	July 25	Sept. 15	———	———
Horehound	1884	June 14	July 28	" 17	" 8	June 23	Sept. 8
Horse Radish	1885	———	———	———	———	———	———
Hyssop	1884	June 26	July 28	June 29	July 30	June 30	Aug. 4
Nigella Sativa	1886	July 12	Oct. 5	" 20	Aug. 10	———	———
Peppermint	1885	Aug. 9					
Rue	1884	May 31	Aug. 12	June 16	Sept. 12	June 13	Aug. 12
Saffron—false	1886	July 26	" 15	July 20	Aug. 14		
Sage, common garden	1883	June 3	———	June 14	July 30	June 6	June 30
Sage, Salvia argentea	1883	" 7	July 5	" 13	" 24	———	———
Sage, Salvia horminum violette	1883	Sept. 15	———	June 8	July 24	———	———
Sorrel	1884	July 1	July 15	" 6	Aug. 8	June 14	July 15
Thyme—French	1884	June 12	———	" 1	July 30	" 5	———
Thyme—Winter	1884	" 2	Aug. 10	" 8	———	———	———

STRAWBERRIES—*A test of yield.*

The following list of strawberries were planted in the spring of 1885. Two rows of each variety, the rows fifty feet long and four feet apart, and twenty-five plants in each row. One row was allowed to form a matted row of plants, the other was kept in hills by cutting off the runners.

The berries upon five plants in each of the rows grown in hills were allowed to remain for exhibition, those upon the other plants in the rows were picked at least every other day.

A record of the number and weight of berries from each row is given with other data in the table on next page.

STRAWBERRIES.	Plants from.	Bloomed.	First berries ripe.	Last berries ripe.	Number of berries calculated per 100 plant.	Ounces of berries calculated per 100 plants.
Bidwell	Purdy.	May 1	June 12	July 6	3267	387
Chas. Downing	Van.	Apr. 29	“ 5	“ 3	2478	340
Cornelia	Lovett.	May 11	“ 11	“ 8	937	227
Daisy Miller	“	Apr. 30	“ 4	“ 6	3731	443
Garretson	Purdy.	May 3	“ 5	“ 5	1521	233
James Vick	Lovett.	“ 6	“ 6	“ 6	5458	548
Jersey Queen	“	“ 18	“ 14	“ 7	823	224
Jucunda	Van.	Apr. 29	“ 1	June 29	94	8
Jumbo	Purdy.	May 3	“ 7	July 6	1470	270
Legal Tender	Lovett.	“ 6	“ 6	“ 2	4506	434
Lennig's White	“	“ 3	“ 6	“ 7	686	113
Longfellow	“	“ 3	“ 6	“ 8	1500	284
Manchester	“	“ 6	“ 10	“ 6	4000	493
“	Purdy.	“ 5	“ 6	“ 6	4768	510
May King	Lovett.	“ 5	“ 7	“ 8	3900	494
Mt. Vernon	“	“ 4	“ 6	“ 8	5894	737
Parry	“	“ 3	“ 8	“ 7	2307	397
Piper's Seedling	“	Apr. 23	“ 5	“ 6	8094	762
Primo	Green.	May 4	“ 14	“ 8	8037	1446
Prince of Berries	Lovett.	“ 8	“ 14	“ 7	3625	585
Sharpless	Van.	“ 5	“ 11	“ 7	3464	627
Wilson	“	Apr. 23	“ 3	“ 1	8750	863
Woodruff No. 1	Green.	May 1	“ 6	“ 9	9758	1288
Kentucky	Lovett.	“ 4	“ 11	“ 8	5811	632

It appears that the Jucunda was the earliest, and the Jersey Queen, Primo and Prince of Berries were the latest.

The Primo gave the largest yield, the Woodruff No. 1 second, and Manchester third. The Jucunda gave the smallest yield.

The fruit of Primo is of large size, color pale scarlet, flesh soft, the flavor is not rich.

The Woodruff No. 1. The fruit averages good size, flat irregular coxcomb shape, color very dark scarlet, flesh very firm ; flavor not of the best.

The fruit of the Manchester very much resembles the Wilson in shape, averaging rather larger, lighter in color, flesh less firm.

The foliage of all varieties during the latter part of the season were more or less affected with blight, that of the Sharpless and May King were least so, and the Wilson, Mt. Vernon, Manchester, Woodruff No. 1 and Lennig's White were more affected than any of the other varieties.

The Jucunda proved nearly a failure this season, a sort of mildew destroying the fruit.

RASPBERRIES.

The list of raspberries in the following table were set out in 1882. The dates of first bloom, first and last ripe fruits were as follows:

RASPBERRY.	Firat bloom.	First ripe fruits.	Last ripe fruits.
Brandywine	May 24	June 26	July 28
Burlington	" 24	" 30	" 19
Caroline	" 24	" 29	Aug. 4
Clarke	" 31	" 28	July 28
Cuthbert	" 24	" 24	Aug. 7
Davison's Thornless	" 22	" 25	July 28
Delaware	" 24	" 28	" 24
Early Prolific	" 24	" 29	Aug. 2
Fastolf	" 24	" 29	July 16
Fontenay	" 24	" 28	Aug. 3
Franconia	" 28	" 30	" 3
French	" 29	" 30	July 24
Gregg	" 31	July 7	Aug. 4
Herstine	" 21	June 28	July 28
Henrietta	" 21	" 28	" 28
Highland Hardy	" 25	" 26	" 16
Knevett	" 29	" 25	Aug. 3
Mammoth Cluster	" 28	July 6	Aug. 7
Mrs. Wood	" 31	June 30	July 28
Naomi	" 25	" 24	" 19
Palluau	" 24	" 25	" 24
Parnell	" 27	" 28	" 28
Philadelphia	" 27	July 1	" 28
Red Antwerp	" 31	June 28	Aug. 2
Reliance	" 28	" 26	July 28
Seneca	" 29	July 3	Aug. 4
Thwack	" 24	June 26	July 16
Turner	" 24	" 24	" 16
Victoria	" 31	July 1	" 28
Yellow Antwerp	June 2	" 1	" 28

The Cuthbert, Palluau and Turner were earliest; the Gregg and Mammoth Cluster were the latest, and the Cuthbert remained in bearing the longest.

The following list of raspberries were set out in the spring of 1885, with the exception of Key's Prolific and Silver Queen, which were set out October 1, 1885.

The data noted appear on next page.

RASPBERRY.	First bloom.	First ripe fruits.	Last ripe fruits.	
Beebe's Golden	May 24	June 30	July 30	Very productive.
Brandywine	" 24	" 23	Aug. 10	Productive.
Caroline	" 31	July 2	" 20	Very Productive.
Crimson Beauty	" 22	June 25	" 10	Productive.
Cuthbert	" 25	" 29	" 10	Productive.
Gregg	" 31	July 5	" 12	Very productive.
Hansell	" 24	June 21	" 2	Moderately productive.
Key's Prolific	" 29	July 2	July 22	Productive.
Lost Rubies	June 1	" 3	Aug. 5	"
Mammoth Cluster	May 31	" 2	July 28	"
Marlboro	" 24	June 24	Aug. 2	"
Miller's Woodland	June 2	July 2	" 14	"
Montclair	May 31	June 26	" 2	Moderately productive.
Nemaha	June 2	July 8	July 29	Not productive.
Ohio	May 29	June 29	Aug. 2	Very productive.
Orange	June 1	" 29	" 2	Productive.
Philadelphia	" 1	July 3	" 2	Productive.
Reder	" 1	June 28	" 4	Moderately productive.
Schaffer's Colossal	May 31	July 2	" 4	Very productive.
Silver Queen	June 7	" 6	" 5	Moderately productive.
Souhegan	May 28	" 1	July 30	Productive.
Superb	" 31	" 1	Aug. 10	Productive.
Turner	June 1	" 2	" 10	Very productive.

The Souhegan was the earliest, the Nemaha was the latest ; the Caroline remained the longest in bearing ; the Key's Prolific ripened the fruit in the shortest period.

The Caroline, Beebe's Golden, Ohio, Schaffer's Colossal, and Turner were the most productive ; the Nemaha was the least productive.

The following varieties of raspberries were set out in the spring of 1886 : Meredith Queen, Erie, Seedling White Cap from H. B. Whitmore, Gulick, Ontario Co., N. Y.; Seedling from Chas Carpenter, Kelly's Island, O.

BLACKBERRIES.

In the following list of blackberries the yield of those set out in 1882 is given, the others were set out in the spring of 1885. The product of two hills is given in the table on opposite page.

BLACKBERRY.	First bloom.	First ripe fruits.	Last ripe fruits.	No. of fruits.	Weight of berries in ounces.
Agawam	May 26	.. ...	......	....	....
Brunton's Early	June 14	July 14	Aug. 23	....	....
Crystal White	......	....	......	....	....
Dorchester	May 28	" 16	" 26	2376	120¾
Early Cluster	June 1	......	....	....	...
Early Harvest	....	....	.. ...	....	...
Kittatiny	May 31	" 22	" 28	519	59¼
Newman's Thornless	" 31	" 22	" 25	1554	194¾
New Rochelle	" 28	" 16	" 28	1848	127
Snyder	" 21	" 19	" 28	956	73
Stayman's Early	" 27	......	....	....	....
Stone's Hardy	" 29	" 28	....	....	....
Taylor's Prolific	" 31	" 25	....	....	....
Wachusett	" 28	" 22	" 17	....	....
Wilson's Early	......	....	....	....	....
Wilson's Junior	" 28	" 19	" 10	..	....

DEWBERRY.	When set.	First bloom.	First fruits ripe.	Last fruits ripe.
Bartell's	1885	May 26	July 6	Pre Aug. 10
Mammoth	1885	" 26	" 10	" 10

Brunton's Early Blackberry was very badly winter killed.

The dewberries noted in the above table made a very vigorous growth of wood, and yielded a few fruits. They appear to be of little value in this locality.

CURRANTS AND GOOSEBERRIES.

The data as noted appear in the tables on next page.

CURRANTS.	When set.	First bloom.		First fruits ripe.		Last fruits ripe.	
Cherry	1882	Apr.	23	June	21	July	6
"	1884	"	23	"	21	"	4
Fay's Prolific	1883	"	23	"	22	"	6
Glorie des Sablous	1884	"	24	"	24	"	4
London Red	1884	"	26	"	21	"	4
Prince Albert	1882	"	27	"	28	"	12
" "	1884	"	27	"	28	"	12
Red Dutch	1884	"	24	"	21	"	6
Short Bunched Red	1882	"	24	"	21	"	6
Versailles	1882	"	23	"	21	"	6
"	1884	"	23	"	21	"	4
Victoria	1882	"	24	"	21	"	6
"	1884	"	24	"	21	"	4
White Dutch	1884	"	24	"	20	"	6
White Grape	1882	"	24	"	24	"	6
" "	1882	"	24	"	22	"	4

BLACK CURRANTS.	When set.	First bloom.		First fruits ripe.		Last fruits ripe.	
Baldwin's Black	1882	Apr.	26	July	1	July	22
Black English	1882	"	26	"	2	"	19
Black Naples	1882	"	28	"	1	"	19
Lee's Black Prolific	1882	"	26	June	26	"	28
Ogden's Black Grape	1882	"	27	"	25	"	24
Missouri Large Fruited	1882	"	26	July	6	"	28
Missouri Sweet Fruited	1882	"	27	"	22	——	

GOOSEBERRY.	When set.	First bloom.		First fruits ripe.		Last fruits ripe.	
Downings	1882	Apr.	23	July	8	July	24
Houghton	1882	"	24	"	10	"	28
Industry	1884	"	23	"	6	"	24
Mountain Seedling	1882	"	24	"	22	Aug.	5
Pale Red	1882	"	24	"	10	July	28
Smith's	1882	"	23	"	10	"	24
Wellington's Glory ? (Eng.)	1883	"	26	"	13	"	28

The Industry gooseberry, which fruited for the first time this season, was the earliest, and the Mountain Seedling the latest. The fruits of the Industry were of large size and free from mildew, and it appears to be a valuable acquisition.

Report of the Botanist.*

The work for the year just past is in line with that of previous years. The investigations upon pear blight have been continued, and some additional features of this important disease of plants elucidated. With the view to obtain a thorough understanding of the subject, and to make all facts, by whomever observed, readily accessible, an index of articles of moment contained in the better known journals and books has been begun, and some of the more important titles included in this report. Additional items relating to the rotting of tomatoes, and to the propagation of the fungus of the clover-leaf weevil are recorded and two fungous disorders, not before mentioned, are taken up. Of the latter, the investigation of the fungus of the plum tree has so far yielded good results, and promises to well repay investigation. The statistics upon the occurrence of weeds are in extension of the observations of last year. The following is the order of topics :

Pear blight.
Rotting of tomatoes.
Disease of clover-leaf weevil.
Mildew of strawberries.
Plum leaf fungus.
Weed statistics.
Important articles on pear blight.

PEAR BLIGHT.

MICROCOCCUS AMYLOVORUS B.

If the attention which this Station has given to the subject of pear blight has a practical bearing (and it is hardly conceivable that this will be seriously questioned) its value must be in the interest of horticulturists more than of any other class. In view of this fact there is something remarkable in the slowness with which the essential and fundamental truths upon which the bacterial explanation of pear blight rests, are grasped by this part of the public. This is brought forcibly to mind by an item in the last number that has come to hand of a leading horticultural journal, which says "the germs of these low orders of vegetation exist everywhere; . . . inoculation of a healthy subject is not demonstration; . . . if any other demonstration has been offered it has not come under notice," etc. If the leaders among horticulturists can come so far short of appreciating the bearing of the facts which demonstrate that specific bacteria cause pear blight, it cannot be amiss to briefly go over the argument again.

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*J. C. Arthur.

Proof that specific bacteria cause pear blight.—(*a*) Bacteria are found in great abundance in actively blighting tissues, so as to be easily demonstrable to the naked eye, and occur in less abundance in proportion as the disease is less active. (*b*) The disease may be introduced into healthy tissue by inoculation with germs from diseased tissue. (*c*) It is communicated with equal certainty when the germs are separated from all accompanying juices of the diseased tissue by a series of fractional cultures. (*d*) *Per contra*, it is not communicated by the juices of the disease, after the germs are removed by filtration. (*e*) The germs connected with the disease constitute a single species, which is essential to successful inoculation. (*f*) *Per contra*, the numerous other species of earth, air and water are not found to a noticeable extent in connection with the disease, and cannot be made to originate it by inoculation, or otherwise.

The experimental data, on which these several propositions are founded, have been abundantly set forth in the two reports preceding the present, and repetition is unnecessary. If there is a weak point in this argument, it is in connection with the third statement (*c*). It is clear that fractional cultures (which in this case extended over a period of three months) do after a time rid the bacteria of all extraneous matter, both diffusible and non-diffusible, originally accompanying the germs used to infect the first culture of the series. But it is possible some product may subsequently be formed in the cultures by the activity of the bacteria, which, introduced into healthy tissue with the inoculating drop from the last culture, acts as the real inciting agent, instead of the bacteria. Several bacterial diseases of animals have been shown to be aggravated or possibly induced by alkaloid poisons which result from the growth of the bacteria. If this were true in pear blight, the third proposition, taken by itself, would lose its force. Some plausibility that this is the case, is found in the oft repeated expression of horticultural writers that the disease is due to "poison" or "poisonous sap" in the tree. If such poisons really exist, they would belong, so far as present knowledge indicates, to the class of alkaloids called ptomaines. To decide the matter of their existence tests were made in April last as follows:

A culture of blight bacteria in about 200 cc. of infusion of potato, giving a vigorous growth with zoöglœa, was filtered and evaporated nearly to dryness, redissolved in alcohol, and then tested with potassic ferric-cyanide, phospho-molybdic acid, and potassio-mercuric iodide, all important reagents in detecting ptomaines.[1] These tests gave no indications of the presence of such compounds. To be doubly sure, the liquid was made strongly alkaline with potassic hydrate, and the tests repeated; the results were the same.

About the same amount of material was prepared by cultivating the bacteria in a preparation of potato and water, cooked over a warm bath, and sterilized. This was filtered, the residue treated with 100 cc. of distilled water, slightly acidulated with hydrochloric acid, heated to 150° F., and filtered. The two filtrates were united, evaporated, and digested in the cold with alcohol made alkaline with sodic hydrate. This solution was tested with the same reagents as before, and also with platinic chloride and concentrated sulphuric acid, with similar negative results.

Another trial, using a cultivation in a boiled potato having only the usual amount of moisture, was made by treating with alcohol acidulated with tartaric acid, heating to 150° F., the solution filtered and evaporated nearly to dryness, and redissolved in distilled water. After an hour it was tested as before, and with uniformly negative results.[2] These tests, carried out under the direction of Mr. E. F. Ladd, assistant chemist of the Station, and a special student of ptomaines, make it very certain that pear blight bacteria produce no poisonous alkaloids during their growth in artificial cultures. No other chemical products of bacterial growth are known to actively promote disease, and the proof is therefore sufficiently complete, that, whatever may be true regarding the growth of the bacteria in the tree, they at least do not behave in artificial cultures in a way to vitiate the force of our third statement.

The fourth statement (*d*), however, already covered this point by implication, for if the fresh juices from the diseased part of the tree would not reproduce the disease when the bacteria were removed, it would not be probable that deleterious products would be subsequently formed in the artificial cultures that could do so. *It is therefore proven, by both direct and circumstantial evidence, that a specific kind of bacteria is the real and only cause of pear blight.*

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[1] See Brieger Ueber Ptomaine, 1885, p. 22 *et seq.*

[2] These experiments have already been published in Proc. Phila. Acad. Sci., 1886, p. 338.

The blight bacteria.—Considerable has been said in previous reports about the organisms which cause blight, and it will be well to give illustrations[1] of them in this connection, to fix the fact that we are not dealing with bacteria in general, but with a single species.

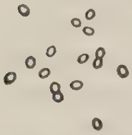

Fig. 1–Bacteria in pear blight from a culture in hay infusion. Magnified 890 diameters.

Figure 1 shows the individual bacteria, greatly magnified, as they exist in the tree during disease. Some of the younger cells are usually to be seen still united in pairs, indicating the mode of multiplication by bipartition. Figures 2 and 3 show forms of zoöglœa varying according to age. The older ones are more irregular and with a convoluted surface. These masses, like the zoöglœa of other species of bacteria, consist of a colorless substance of a gelatinous consistency in which the bacteria are thickly imbedded. This ground substance sometimes extends beyond the mass of bacteria, as in figure 4, forming a clear envelope, which separates the mass from the surrounding bacteria. It is generally conceded that this is a resting state of the organism.

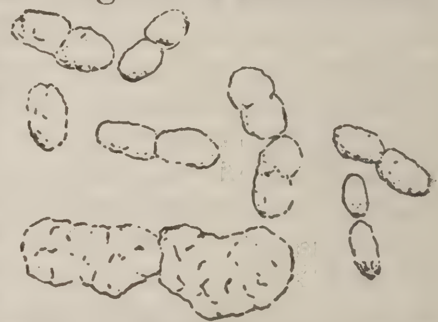

Fig. 2.–Small zooglœa from a culture in potato infusion, drawn from a preparation in Canada balsam. Magnified 890 diameters.

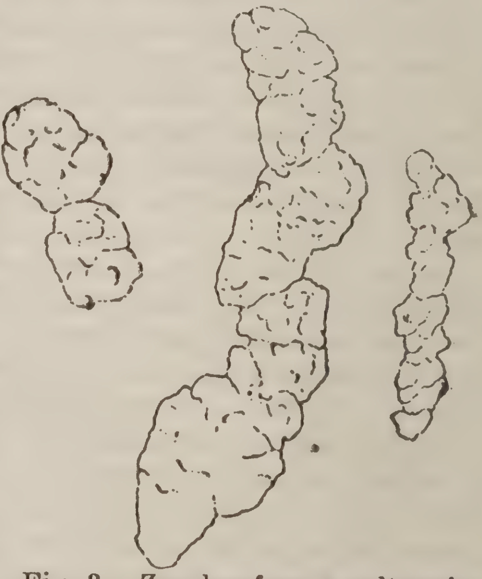

Fig. 3.—Zooglœa from a culture in potato infusion. Magnified 890 diameters.

In the case of pear blight the zoöglœa have only been observed in liquid cultures, and not in the tree. At what time or under what circumstances they occur in nature, it is impossible at present to say, but it is not likely to be while the bacteria remain in the tree.

The form of these zoöglœa is one of the most characteristic features in the development of the blight bacteria. A more extended and systematic description of the species and its development has been published elsewhere,[2] to which the reader is referred for further information.

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[1] Taken by permission from the Proceedings of the Phila. Acad. of Nat. Sciences, 1886, Pl. III, from an article by the writer.

[2] Burrill in Amer. Nat., Vol. VII, 1883, p. 319 ; Arthur in Proc. Phila. Acad. Sci., 1886, p. 317.

The disease in other than pear trees.—It is generally recognized that the disease is most strongly manifested in the pear and cultivated crab-apple; in the common apple and the quince it is less destructive; it has been established, partly by experiment and partly by observation, that, in a less degree, it also affects the mountain ash, service-berry, English hawthorn and other thorns. During the last season this list has been extended by the successful inoculation of the fruit and branches of the wild crab-apple, Pirus coronaria, in which the disease took as readily and progressed as rapidly as in the common apple. It would be interesting to know if, during a season of epidemic, the wild crab-apple is not attacked by the disease like the common apple.

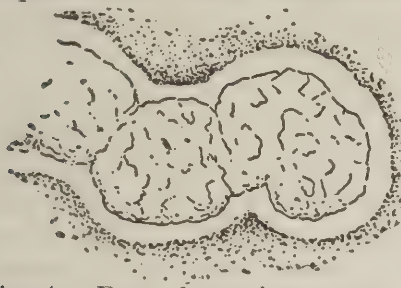

Fig. 4.—Part of zooglœa mass showing an envelope free from bacteria. Magnified 890 diameters.

Several writers have expressed the belief that the same disease affects a number of other designated trees and shrubs, not belonging to the pome family. Some of these suggestions have been acted upon, and their trustworthiness put to the test, by a series of inoculations with the blight virus.

On June 8 three succulent shoots of an elderberry (Sambucus Canadensis) were inoculated with fresh virus washed from blighting pear twigs, and at the same time the same virus was used to inoculate the young shoots and fruits of quince, and the fruits of Bartlett and Seckel pears. The pear and quince inoculations set up the disease, but no more effect was produced on the elderberry than if pure water had been used instead of blight germs. The experiment was repeated on June 18 with uniform results. In no respect could the conditions be more favorable for conveying the disease than were secured in these trials, and the absolute failure of the elderberry to be infected must be considered ample proof that it is not a susceptible plant.

On June 10 succulent and vigorous shoots of Abele poplar (Populus alba) and of balm-of-Gilead (Populus balsamifera. var.) were inoculated in the usual way. In each instance the wounds healed the same as if no virus had been applied.

The experiments of each succeeding season make the conviction stronger that only pomaceous species are susceptible to this disease.

Internal conditions affecting the disease.—The factors which modify the growth and activity of the germs within the plant yet remain comparatively obscure. Why one species of bacteria will thrive in the living tissues of a pear tree, while none other will, may never be fully known, but some of the controlling conditions are undoubtedly within the range of discovery.

Several investigators have expressed the opinion that the acidity of plant tissues prevents, to a large extent, the growth of parasitic bacteria, for most forms are very sensitive to acids. This has suggested the acidulation of artificial cultures. From a limited number of cultures it was learned that one-half of one per cent of malic acid added to potato solution prevented turbidity and the formation of a pellicle. The chief microscopic evidence of growth in this case was a light fleecy sediment, which was found to be composed entirely of blight bacteria. Increasing the amount of malic acid to two per cent., only diminished the growth of the bacteria, without entirely arresting it. With five per cent. of citric acid some growth took place, but none at all with the same amount of tartaric acid.

The experiments show that the blight bacteria can grow in the presence of a relatively large amount of fruit acids. This corresponds with preconceived opinions, and with the fact that the normal juices of the pear and apple are strongly acid to test paper. It is also found that the expressed and filtered juices of green pears make excellent culture liquids, without neutralizing.

From the beginning of these studies both observation and experiment have pointed to a connection between the activity of the disease and the succulency of the tissues.[1] The inference has been chiefly founded upon the certainty and rapidity of the disease when inoculated into more succulent tissues, and from the behavior of the bacteria in fresh pear fruit supplied with a varying amount of water. It is well known to every horticulturist that a rapid, succulent growth, brought about by high cultivation, or by any other means, is the condition which favors the disease. In 1866 Mr. W. C. Flagg[2] called attention to the percentage of water in the heartwood, sapwood and bark of the apple and pear, determined by Emmons[3] as follows:

	Heartwood.	Sapwood.	Bark.
Pear	22.05	48.80	63.70
Apple..........	33.35	39.10	59

He inferred from these figures that "in the less density of pear wood and the greater amount of water in its sapwood, we have probably one of the conditions of its greater liability to blight." Summarizing the data of Emmons we learn that the pear contains one per cent. more water than the apple.

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[1] Report for 1884, p. 362; for 1885, p. 246.

[2] Proc. Mo. Hort. Soc. for 1866, p. 401.

[3] Rep. U. S. Pat. Office for 1849, p. 475.

Fuller data on the amount of water in pear, apple and quince are given by Penhallow[1] from recent determinations. He took branches "representing on the one hand the growth of two years, and on the other hand the growth of four years," gathered at different seasons of the year. His results were as follows :

	February.		March.		April.		September.		December.	
	2 years.	4 years.	2 years.	4 years.	2 years.	4 years.	2 years.	4 years.	2 years.	4 years.
Pear......	49.9	47.7	49.7	48.1	55.4	54.0	54.0	51.5	53.7	50.0
Apple	49.5	44.8	45.7	41.5	49.0	46.4	56.2	54.5	48.3	59.0
Quince....	45.5	39.6	......	......	......	......	56.3	52.6	......	......

The most important part of the year for our purposes, May, June and July, in which the disease is most active, is not covered by this table. It is, however, interesting to note that for the time given the several percentages of water in the apple and quince are for the most part less than the corresponding ones in the pear. Averaging the amounts for the pear and apple (the data for the quince being too imperfect for use) we obtain the following results :

Averages.	Pear.	Apple.
Two years' growth for the five months................	52.5	49.7
Four years' growth for the five months	50.2	49.2
Total average for the five months	51.4	49.4

These figures show a difference of two per cent. of water in favor of the pear, which is doubtless a larger difference than that obtained from Emmons' figures, because younger growth was taken. This is evidently true, when we look at the difference in the branches having four years' growth which show but one per cent., while those of two years' growth show nearly three per cent. difference.

These data sufficiently demonstrate that a pear tree contains more water as a rule than an apple tree. This coincides with the fact that the pear blights more easily than the apple. But if these are to be laid down as correlative facts, it should also hold true that a Bartlett pear has more water than a Seckel, as there is as much difference between these two varieties of pears regarding their readiness to blight as between some varieties of pears and apples. It was to settle this question that the several determinations of the accompanying table were made. In each case the whole of the last period of growth was taken. A handful

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[1] Amer. Naturalist, Vol. XX, 1886, p. 429.

DETERMINATION OF MOISTURE IN TWIGS, 1886.

Date	VARIETY.	Weight fresh	Weight dried	No. of twigs	Average length, inches	Percentage of water.	Average percentage,
Jan. 14	Pear—Bartlett	36.05	18.	9	9.	50.1	50.2
"	" "	37.85	18.8	10	7.8	50.3	
"	" Seckel	27.81	13.6	14	5.6	51.1	51.05
"	" "	29.3	14.35	14	6.	51.	
"	" Flemish Beauty	24.71	11.68	13	5.6	52.7	52.6
"	" " "	30.85	14.65	18	5.	52.5	
"	" Buffum	45.26	21.71	13	6.3	52.	51.7
"	" "	31.4	15.26	9	6.4	51.4	
"	" Boussock	41.6	20.3	20	5.2	51.2	51.15
"	" "	53.7	26 25	24	5.3	51.1	
"	" Beurré d'Anjou	33.55	16.2	13	4.8	51.7	51.45
"	" " "	36.3	17.7	14	5.	51.2	
"	" Duchesse	18.8	9.5	13	5.1	49.5	50.1
"	" "	28.8	14.2	13	5.8	50.7	
"	" Mt. Vernon	55.54	28.23	20	7.1	49.2	49.4
"	" "	54.3	27.35	20	7.1	49.6	
Feb. 15	" Bartlett	59.97	30.07	22	6.2	49.9	50.2
"	" "	55.9	27.66	26	5.6	50.5	
"	" Seckel	50.3	24.9	24	6.	50.5	50.85
"	" "	47.85	23.35	18	6.6	51.2	
"	Apple—Baldwin	25.06	12.58	14	5.7	49.8	49.7
"	" "	25.8	13.	16	4.7	49.6	
"	" Russet	33.54	18.74	16	8.6	44.1	45.95
"	" "	34.43	17.98	15	7.9	47.8	
"	" Esopus Spitzenburgh	42.33	21.4	20	6.3	49.4	49.6
"	" " "	33.63	16.97	17	5.9	49.8	
"	Peach	38.5	18.03	23	7.9	53.2	53.
"	"	44.48	21.	24	8.2	52.8	
"	Mountain Ash—European	38.94	20.49	18	8.	47.4	47.45
"	" " "	38.70	20.35	26	7.7	47.5	
"	Hawthorn—English	25.47	13.71	22	7.7	46.1	47.4
"	" "	29.81	15.3	23	8.3	48.7	
April 30	Pear—Boussock	34.8	14.88	19	5.1	57.2	57.6
"	" "	28.05	11.81	15	5.	57.9	
"	Apple—Russet	24.19	10.87	17	5.1	55.	55.6
"	" "	21.20	9.11	12	6.1	56.2	
"	Hawthorn—English	14.87	7.28	13	7.5	51.	51.1
"	" "	12.	5.85	14	6.6	51.2	
June 11	" "	11.09	4.14	14	7.9	62.7	61.9
"	" "	10.26	4.	16	7.8	61.	
July 1	Pear—Bartlett	23.7	8.76	13	6.7	63.	63.15
"	" "	15.4	5.65	10	5.94	63.3	
"	" Seckel	27.	9.38	13	5.63	65.3	66.75
"	" "	26.82	8.8	10	6.15	67.2	
July 9	" Bartlett	19.62	6.91	13	6.72	64.8	64.55
"	" "	26.45	9.45	19	6.59	64.3	
"	" Seckel	32.1	10.42	19	6.68	67.5	66.6
"	" "	34.3	11.76	18	6.51	65.7	
"	" Flemish Beauty	16.8	5.9	13	6.24	64.9	64.15
"	" " "	19.1	7.	14	6.46	63.4	

of the twigs of each variety, of as uniform length as possible, and with the exception of those of July 9 each handful from a single large tree, was gathered, and before weighing was divided into two parts without selection. The determinations are thus in as close duplicate as it was possible to secure ; the last column gives the average of each pair of duplicates. The twigs gathered July 9 were from a large number of young trees in nursery rows. In all cases where the leaves were present they were carefully removed before drying, in order to have all determinations strictly comparable. The drying was done at 100° C., the weights taken in grams and the lengths in inches.

The statistics of this table seem sufficiently complete for the winter months, but are defective for the growing season. Turning at once to a comparison of the moisture in the Bartlett and Seckel pears, as representing the extremes in capacity for blighting, it is a surprise to find that the variety that is less influenced by blight, the Seckel, shows a constantly higher percentage of water than the other, with other incongruous facts. In view of this conclusion, it is unprofitable to institute further comparison of varieties until more statistics are in hand, as the results appear to be anomalous and unexplainable. Averaging all the percentages for the pear and all those for the apple, the results fall into line with those deduced from Emmons and Penhallow's data, the larger percentages being explained by the younger growth and the time of year the material was gathered.

	Pear.	Apple.
Percentage of water obtained by Emmons	44.84	43.81
" " " Penhallow	51.4	49.4
" " " Arthur	57.8	52

As the flowers are an important part of the plant in its relation to the blight, a set of determinations were undertaken at the time the flowers were beginning to open, to see if the percentages of water in the twigs plus the flower clusters bear the same relation to each other that those of twigs alone do. Here we find that the Bartlett shows a somewhat higher amount of moisture than the Seckel, but is itself exceeded by the Boussock and Flemish Beauty, both of which varieties are also much given to blighting. The varieties of apple show less moisture than those of the pear, and the mountain ash, which blights somewhat like the apple, is not much above it in moisture. But the figures of this table must be accepted with considerable allowance, on account of the difficulty of selecting examples from the several varieties that represented them at the same stage of development.

DETERMINATION OF MOISTURE IN TWIGS AND FLOWERS.

Date.	VARIETY.	Weight fresh.	Weight dried	No. of twigs.	Average length, inches	Percentage of water.	Average percentage.
Apr. 30	Pear—Bartlett	19.78	6.24	7	2.9	68.5	68.7
"	" "	24.2	7.55	8	3.5	68.8	
"	" Seckel	28.03	9.52	11	3.9	66.	67.3
"	" "	24.78	7.79	9	3.6	68.5	
"	" Flemish Beauty	25.07	6.99	8	3.1	72,1	72.4
"	" " "	22.54	6.15	6	3.	72.7	
"	" Boussock	37.78	11.11	10	3.3	70.6	71.2
"	" "	39.67	11.2	10	3.4	71.8	
"	Apple—Baldwin	24.12	9.12	8	5.	62.2	61.4
"	" "	23.88	9.4	8	3.7	60.6	
"	" Russet	32.2	14.45	6	6.	55.1	57.7
"	" "	36.46	15.81	7	5.7	59.4	
"	" Esopus Spitzenburgh	30.88	11.8	10	4.4	61.8	62.2
"	" " "	29.34	10.94	10	4.5	62.7	
"	Mountain Ash—European	26.65	8.37	7	3.7	64.8	65.3
"	" " "	32.	10.98	9	4.4	65.7	

A more satisfactory series of percentages, in respect to accuracy, was obtained from the fruit. The first lot was taken when the fruit was something over one-half grown, and the second lot when full size and approaching ripeness. Each pear was quartered, and the quarters distributed, so that even closer duplicates, if possible, were secured than with the twigs. This table represents a relationship that corresponds very well to experience regarding the tendency of each variety to blight, with the exception that the Buffum should stand above the Seckel, instead of being the lowest of the series. But this exception need not be made if we consider the progress of the disease in the fruit itself, when introduced by artificial inoculation or otherwise. It is not known, however, what relation exists between the succulency of the fruit and other parts of the tree, and this table, therefore, helps us but little in solving our problem.

It is interesting to note that in sixteen determinations of the fruit of the Buffum pear, made under as closely identical conditions as it was possible to devise, a variation of 1.6 per cent. occurs, with an extreme variation from the mean of nine-tenths of one per cent. Using these figures and applying the formula,[1] plus or minus 0.6745 into the square root of $\frac{S}{n-1}$ in which S is the sum of the squares of the differences between each separate observation and the average of all, while *n* is the number of observations, we obtain plus or minus .3%, as the probable error for any single observation of a similar kind. Dividing this result by the square root of the number of observations made in any series will give the probable error of the final result, or average of the whole for any similar set of determinations. Thus the probable error for the average of 79% in the sixteen determinations of the water in Buffum pears is plus or minus .3 divided by the square root of 16 = plus or minus .07%. This shows that the error in the table of percentages of water in pear fruit, that may be ascribed to imperfect manipulation, defective apparatus, the personal equasion, etc., is very small, not exceeding three tenths of a per cent. between any two single determinations. The per-

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[1] Kohlrausch's Physical Measurements, Eng. tr., 1874, p. 2.

DETERMINATION OF MOISTURE IN FRUIT.

Date.	VARIETY.	Weight fresh	Weight dried	No. of fruit.	Percentage of water.	Average percentage.
July 1	Pear—Bartlett	52.2	11.5	2	79.7	79.3
"	" "	62.58	13.2	2	78.9	
"	" Seckel	23.46	5.33	2	77.3	77.
"	" "	19.05	4.44	2	76.7	
"	" Flemish Beauty	34.9	7.67	2	78.	77.55
"	" " "	35.	8.	2	77.1	
"	" Buffum	20.98	5.2	2	75.2	74.8
"	" "	24.4	6.25	2	74.4	
Aug. 9	" Bartlett	213.5	42.14	2	80.3	80.45
"	" "	201.65	39.03	2	80.6	
Aug. 10	" Flemish Beauty	117.96	19.78	2	83.2	83.4
"	" " "	115.6	19.	2	83.6	
"	" Seckel	58.76	12.22	2	79.2	79.5
"	" "	54.42	11.03	2	79.7	
"	" "	64.3	13.33	2	79.3	
"	" "	60.	12.1	2	79.8	
"	" Buffum	79.45	17.21	2	78.3	79.
"	" "	74.28	16.03	2	78.4	
"	" "	73.34	15.75	2	78.5	
"	" "	63.2	13.5	2	78.6	
"	" "	75.7	16.1	2	78.7	
"	" "	82.07	17.35	2	78.9	
"	" "	73.82	15.5	2	79.	
"	" "	74.41	15.55	2	79.1	
"	" "	70.3	14.69	2	79.1	
"	" "	66.46	13.9	2	79.1	
"	" "	75.3	15.73	2	79.1	
"	" "	69.58	14.5	2	79.2	
"	" "	81.6	16.86	2	79.3	
"	" "	64.18	13.1	2	79.6	
"	" "	65.74	13.37	2	79.7	
"	" "	64.54	12.95	2	79.9	

centages for twigs must be more variable than those of the fruit, on account of the greater variability of the material, but the exact figure was not determined.

The difference in the amount of water in branches making different rates of annual growth is admirably shown in the accompanying table. All the material was selected from several large pear trees standing in the garden, and differed in no important way except as modified by slow or rapid growth. The old spurs were the product of several, probably many, years of continuous healthy growth, having elongated less than an inch each year, and were somewhat branched. The other lots were composed of the total growth of the previous year only, one lot containing twigs not exceeding four inches, and the other those reaching nearly two feet. The amount of water in each is shown to be directly proportional to rates of yearly growth. This result is all the more marked as the determination was made in the dead of winter when the water in the plant is approximately at an equilibrium ; the differences must be much more prominent during the period of active growth. The significance of the observation is the more apparent when the difference between the extremes is compared with the greatest differences obtained between the varieties under like conditions.

DETERMINATION OF MOISTURE IN TWIGS OF BUFFUM PEAR.

Date.	KIND OF BRANCHES.	Weight fresh.	Weight dried	No. of twigs.	Average length, inches	Percentage of water.	Average percentage.
Jan. 14	Spurs of several years' growth.	30.1	16.33	7	4.1	45.8	46.2
		30.41	16.2	6	4.8	46.7	
		24.1	13.	5	5 2	46.1	
"	Short twigs of previous year. .	7.79	3.91	9	3.3	49.8	50.4
		5.68	2.8	6	3.5	50.7	
		8.3	4.1	7	4.	50.6	
"	Long twigs of previous year. . .	45.4	21.38	2	22.	52.9	53.3
		41.89	19.6	2	21.9	53.2	
		45.61	21.1	2	24.9	53.7	

EXTREME VARIATION OF THE PERCENTAGE OF WATER IN THE PEAR.

	Jan. & Feb.	April.	July.	July.	Aug.
	Twigs.	Twigs & flow'rs.	Twigs.	Fruit	Fruit.
Like parts from several varieties....	3.2	5 1	3.6	4.5	4.4
Shoots of the same tree........	7.1	....	... .	....	....

The fact that this difference far exceeds the greatest difference yet found between like parts of the most diverse varieties is, indeed, suggestive. To state it in another way—the greatest variation yet found between varieties of the pear in regard to succulency is much exceeded by the variation between the parts of the same tree.

Chemical changes.—Only an imperfect understanding yet exists of the chemical transformation brought about in the tree by the activity of the blight bacteria. The year's work has contributed somewhat to the subject.

To determine if the sugar of the plant was increased or decreased by the bacteria, the following tests were made, with the assistance of my colleague, Mr. Ladd. Immature pears, thoroughly permeated with blight from inoculations made eight days before (June 28), were contrasted with sound pears taken from the same tree at the same time and subjected to like treatment. Four or five pears of each kind were taken, the sound ones weighing 141.1 grams, and the blighted 111.6 grams. The sound fruit yielded 3.94 per cent. of fruit-sugar, and the other 1.61 per cent., showing a large loss of sugar to be charged without doubt to the action of the bacteria.

The solutions used in the preceding analyses, which were formed by digesting the material in alcohol, afterwards rinsing in water, and to the combined solutions adding enough water to reduce the alcohol in the solution to less than 20 per cent., were tested viscometrically by my colleague, Dr. Babcock. The result[1] gave 156 for the sound and 280 for the blighted fruit. These numbers represent the number of grams of sugar which it would be necessary to add to a litre of water to secure the same viscosity. By referring to the percentages of sugar already found in these same solutions, it will be seen that the solution from the sound fruit contained 39 grams of sugar to the litre, and the other 16 grams. Subtracting these numbers from the viscosities, leaves 117 and 264 as the respective indices of sound and blighted fruit when the sugar is eliminated. The substance which may be regarded as chiefly increasing the viscosity of a solution from blighted fruit over and above that from sound fruit is probably the gum or gum-like substance formed by the bacteria. The difference between 117 and 264, *i. e.*, 147, may be taken to represent the viscosity of this substance in blighted fruit. This number is so large that evidently only a small part of the gum is derived from the conversion of sugar, probably not even a fifth. It has been conjectured that starch contributes most largely to the formation of the gum, but although this is probable, there is no direct proof of it.

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[1] For the method of procedure see the chemist's report in this volume.

Solutions from sound and blighted pears were also tested with Soleil's saccharimeter, but without securing sufficiently uniform conditions to make the results worth recording. All that need be said is that both solutions were found to be lævo-rotatory, with a less percentage of sugar in the solution from blighted fruit.

Can the common expression of horticulturists, that blight is connected with a "poison" or "poisonous sap," be taken literally? To find an answer to this question, freshly and thoroughly blighted Bartlett pears (inoculated July 6 and gathered six days after) were tested for ptomaines, with Mr. Ladd's assistance. Two such pears were digested with alcohol acidulated with tartaric acid, then with pure alcohol, the two solutions put together, filtered, evaporated to a syrup, and redissolved in ether. The following reagents were then successively employed—gallic acid, iodine in iodide of potassium, ferric potassic-cyanide, concentrated sulphuric acid, platinic chloride, potassio-mercuric iodide, and phospho-molybdic acid—without securing any ptomaine reaction. It is therefore sufficiently proven that no real poison exists in connection with this disease.

Blight bacteria in dead matter.—Experiments have shown that the germs retain their vitality for a considerable time in limbs cut from the tree and thrown upon the ground. The most interesting result came from cultures started with the inner bark of a blighted limb that was cut from the tree in midsummer and thrown into a tank of water in the garden. In the fall the water was drained off, but the sediment remained moist till spring, the examination taking place the middle of April. After a period of nine months under these circumstances the bacteria were found to be alive, and in a growing condition.

A solution was made by treating soil with boiling water, filtering and sterilizing. This gave a nutritive solution in which the bacteria grew with moderate readiness, producing a pellicle and zoöglœa. A culture of this kind started with germs from the quince, reproduced the disease in a Bartlett pear tree by inoculation.

The two facts that blight bacteria may retain their vigor in dead limbs from one season to another, and that they can thrive in garden soil, make it evident that it is the part of cautious treatment to burn all blighted limbs when taken from the trees, and to remove affected limbs before they drop the exudation that may convey the germs to the soil.

Index to literature of pear blight.—Probably no disease of plants has been more written about in America than the pear blight. The list of authors, which is being prepared by the writer, already contains several hundred names, although still quite incomplete. Taking the whole range of the literature, much careful observation has been recorded, which in the light of present knowledge, becomes specially interesting and of practical importance. A few selected titles of the more important articles which have appeared from time to time are appended to this report, and will serve to outline the trend of thought upon the subject from the earliest record yet found to the present. The early history of the disease is obscure, only one item having yet come to hand antedating 1800. The writer will be glad to receive information of articles or items on the subject printed in the last century.

Summary.—The salient results of the year's work may be summed up as follows: The direct proof that the disease is due to specific bacteria has been strengthened. Experiment has shown that the wild crab-apple is susceptible to the disease, while the elderberry, Abele poplar and balm-of-Gilead are not. The bacteria are able to grow in the presence of a relatively large amount of fruit acids, which may partially account for their adaptability to the acid tissues of the living plant. There is found to be a rather constant ratio between the percentages of water in the branches of the several kinds of pome fruits, corresponding to some extent with their liability to blight, but this relation is not yet established for the several varieties of a single kind, *e. g.* pears, although it appears to be essentially true, if the percentages of water in the fruit alone are considered. The popular opinion, that the more rapid the growth of shoots, the more succulent their tissues and the more liable to blight, is confirmed by trial. The amount of sugar in the tissues is found to be diminished by the disease, being presumably converted into gum by the bacteria. It is shown that no true poisons exist in connection with the disease. The bacteria may keep alive in branches cut from the tree and remaining in water or moist ground till the following season, and they may also be cultivated in solutions of garden soil, indicating the desirability of promptly destroying all blighted limbs.

ROTTING OF TOMATOES.

Another year of observation on tomatoes strengthens the opinion that the rotting of the fruit is not brought about by a single agency, but by several, sometimes combined, but more usually acting independently. No rotting of the green fruit occurred this season among the sixty or more varieties grown in the Station garden, although there was the usual, possibly more than the usual, rotting of the ripe or nearly ripe fruit.

The rot in green fruit is undoubtedly due to fungi ; and probably Dr. Halsted[1] is correct in ascribing the decay which he studied to Cladosporium fulvum, but there is no ground for referring that observed by Mr. Goff[2], Prof. Bailey[3] and myself[4] to the same fungus, although part of it may, or may not, have been due to it.

Whatever may be the cause of rotting of green tomatoes, the rot in ripe tomatoes, as observed the present season especially, must be ascribed to fermentation, chiefly acetic. The fermentive action is evidently not begun until the resistance of the living tissues is greatly reduced, or entirely lost. This may be brought about in several ways. All fruit reaches this condition of inability to resist the inroads of disease germs, or of germs of disintegration, when it becomes fully ripe—literally dead ripe. The condition may be prematurely brought on by anything which decreases the vigor of the plant, and thus enfeebles and shortens the life of its ripening tissues. A marked, and from several points of view an interesting, example of the early and extensive rotting of ripe fruit in plants constitutionally debilitated by propagation for three seasons from seed successively selected from the feeblest plants of the preceding year, is recorded by Mr. Goff[5], in which finally half the ripe fruit prematurely rotted.

This kind of decay is very appropriately called "soft rot," and is well described by Mr. Goff as follows : "The fruit becomes soft and collapses without changing color ; the skin finally bursts, permitting the contents to flow out, when it dries without detaching itself from the stem." If the fruit rests upon the ground, it often cracks open, and the exposed surface becomes speedily covered with a white velvety growth[6], composed of yeast and Oidium lactis, which for a considerable time prevents the contents from escaping. This white growth, with the associated bacteria, is only a more obvious development of the active agents of fermentation which destroys the fruit.

The main objects of this note are (*a*) to point out that the study of the tomato rot will be advanced by discriminating between the soft rot, chiefly affecting ripe fruit, and other kinds, largely brown or black and not soft, chiefly affecting green fruit, and that (*b*) one means of avoiding the former is to maintain the health and increase the vigor of the plants by judicious breeding, but that for the latter no remedy or preventive is known.

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[1] Proc. Soc. Prom. Agric. Sci. for 1883-4, p. 42.

[2] Rep. N. Y. Agric. Exper. Station for 1882, p. 138; 1883, p. 195; 1884, p. 227; 1885, p. 183.

[3] Bul. Agric. Col. of Mich., No. 19, p. 5.

[4] Rep. N. Y. Agric. Exper. Station for 1884, p. 379; 1885, p. 249.

[5] Ante, p. 173; report for 1884, p. 227; 1885, p. 182.

[6] Described and illustrated in Rep. N. Y. Ag. Ex. Station for 1884, p. 380.

DISEASE OF CLOVER-LEAF WEEVIL.

ENTOMOPHTHORA PHYTONOMI ARTH.

The larva of this beetle, Phytonomus punctatus, was found upon the lawn as early this year as April 26, and for some time afterward, then disappeared, as it did last year, until fall. The larvæ seen were all sick with the disease caused by the fungus, Entomophthora Phytonomi, described in the last report.* The insect was far less abundant than last year, and no full grown larvæ were to be found. The disease seems to have nearly or quite exterminated it from this locality, for the number was so far decreased by fall that but a single larva was detected (on November 9), although diligently searched for.

The late occurrence last fall (November 20) of diseased larvæ without resting spores, and their early appearance this spring (April 26), in the same condition as last seen in the fall, makes it evident that the mycelium of the fungus hibernates in the bodies of the living larvæ during winter, thus avoiding the necessity for the production of resting spores, which up to the present time have not been detected.

The germination of the summer spores under water, by the production of mycelial threads, is described in the last report. Further study this season reveals the fact that when the spores are germinated upon the surface of water, or in sufficiently moist air, they take on a different development. Instead of at once producing mycelium they send out a short slender pedicel from one side (Fig. 5), which bears a solitary minute spore. The minuteness of these secondary spores, and their aërial formation, makes it evident that they serve for long distance transportation by wind. Their germination was not studied.

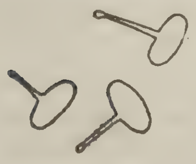

Fig. 5—Germination of spores on the surface of water. Magnified 200 diameters. Original.

STRAWBERRY MILDEW.

SPHÆROTHECA CASTAGNEI LEV.

There is a large class of surface or powdery mildews (sometimes called blights), of which the best and most widely known is doubtless that which envelops the pea vines with a hoary coating in midsummer. All the forms are like the pea mildew in so far that they all, or nearly all, produce a delicate white cobwebby growth which overspreads the plant attacked, and gives it a whitened grayish appearance. In summer, especially in July, the fungus throws off a great quantity of colorless spores conidia) which promote its rapid propagation and distribution. The powdery appearance at this time, which all close observers have noticed, is due to the accumulation of the undetached spores. Later in the season the resting or winter spores are formed in minute globular spore-cases, which are first yellow, then change to black as they ripen. The fungus does not penetrate the plant on which it grows, but remains entirely upon the outside, and derives its nourishment by absorption through the cell walls.

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*Report for 1885, p. 258.

I find no record of a surface mildew upon the strawberry. It first came under observation on the grounds of the Station in the middle of June of the present year, and was noticed on the fruit of the Jucunda first, attracting attention from the unpleasant musty taste it imparted. The fruit, especially the so-called seeds (akenes) and the fruit stems were whitened with the fungus ; it also overran, although less conspicuously, both surfaces of the leaf blade and the leaf stalk. Both ripe and green fruit were equally covered, but it showed best on the former owing to the color. The central portions of the thickest masses were most affected, but it also appeared on isolated plants ; it did not, however, spread over the whole plant, some portions remaining quite unaffected. A large number of varieties were growing near together, of which besides Jucunda, the Mt. Vernon, May King and Garretson were somewhat affected, while intervening varieties nearly or wholly escaped.

The fungus in this instance is not a new one, but a very common form appearing every season upon a variety of plants, especially weeds. The dandelion is particularly subject to it, and has given occasion for some observations that are of interest in this connection.

There are five rows of dandelion growing in the Station garden. The middle row, named Ameliore Tres Hatif, having broad plain leaves has mildewed badly during the two years it has been under observation. The moss-leaved variety, Mousse of Vilmorin, with much dissected and curled leaves, standing beside the last, was slightly affected; the other rows entirely escaped. The interesting point is that the fungus, which adapts itself readily to plants of the most diverse nature, yet does not attack varieties of the same species with equal readiness.

It is the same fungus which frequently proves detrimental to hops, mildewed vines giving but a partial harvest in proportion to the severity of the attack.

The interest that the gardener is likely to have in the subject of mildewed strawberries lies chiefly in a knowledge of the kind and nature of the fungus. When the mildew is first noticed upon the ripe berries, it will usually be too late to administer any remedies. If it is seen earlier some fungicide might be applied to check its spread. What this should be must be determined by future experiments. Thoroughly dusting sulphur upon the dandelion has failed to remove the mildew, and is not likely to be more efficacious on the strawberry; some liquid application will probably serve better. An English gardener[1] is successful in clearing his strawberries (presumably grown under glass) from mildew (probably the same as mentioned above) by spraying with a solution of one-fourth ounce of sulphide of potassium to a gallon of water. Twice the strength did no harm to the plants. If a remedy is needed this one is well worth trial.

In any case the strawberry plants are weakened by the growth of the fungus, the fruit is rendered uninviting and unpalatable, while there is a possibility of a partial loss of the crop, giving good reasons for calling attention to the subject at this time.

PLUM-LEAF FUNGUS.

SEPTORIA CERASINA PK.

Very little can be found in horticultural literature unquestionably relating to the malady of the plum which this parasitic fungus causes. This probably does not arise from the restricted distribution or rare occurrence of the injury, but from its being confounded with normal autumnal ripening of the leaves. Its most prominent feature is the premature shedding of the leaves; and early defoliation is supposed in severe cases to be abnormal only in being hastened by the malinfluence of the weather, such as drouth or heat, or by the sterility of the soil. The real cause may more often be traced, however, to the action of an endophytic fungus, the one named above, which saps the life of the leaf and produces an unnatural ripeness.

The fungus first becomes conspicuous to a careful observer about the middle of July. It starts at isolated points on the leaf blades, apparently from spores derived from the air, and spreads in a circumscribed area, usually not exceeding an eighth of an inch in diameter, and more commonly but half that size. These spots are usually more or less rounded, but may be angular when bounded by the veins. They are dull, or even bright, red on the upper surface of the leaf, with or without a whitish dot in the center, and brown or reddish brown beneath. In abundance they range from a few on each leaf to such numbers as to become confluent and cover nearly the whole surface. After a time a pustule forms at the center of each spot beneath, which becomes clearly noticeable, especially under a lens, is pale yellowish brown in color, and when mature discharges a considerable mass of whitish spores. The spores being agglutinated, sometimes form tendril-like threads, but more often spread out into irregular masses, or are washed down by rain into a white film. In August and September the quantity of spores produced on the under surface of plum leaves is often so abundant as to be clearly apparent to the naked eye. The form of the spores, as seen under the microscope, is given in Fig. 6; Fig. 7 shows a verticle section through a pustule, from which the spores have been largely removed to give a better view of the manner in which they arise from the fertile layer of vertical threads.

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[1] S. Cornhill, in Garden, Vol. XXVIII, 1885, p. 39.

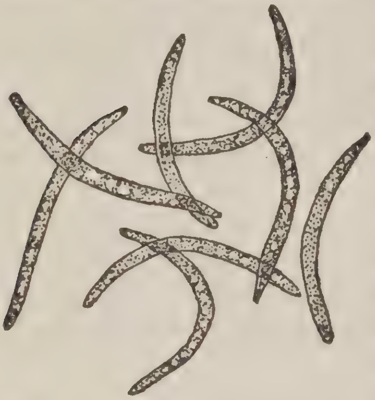

Fig. 6.—Spores of Septoria cerasina, taken from plum leaves in August. Magnified 430 diameters. Original.

The primary injury which the fungus does the plum tree is twofold; it robs the tree of nourishment diverted to

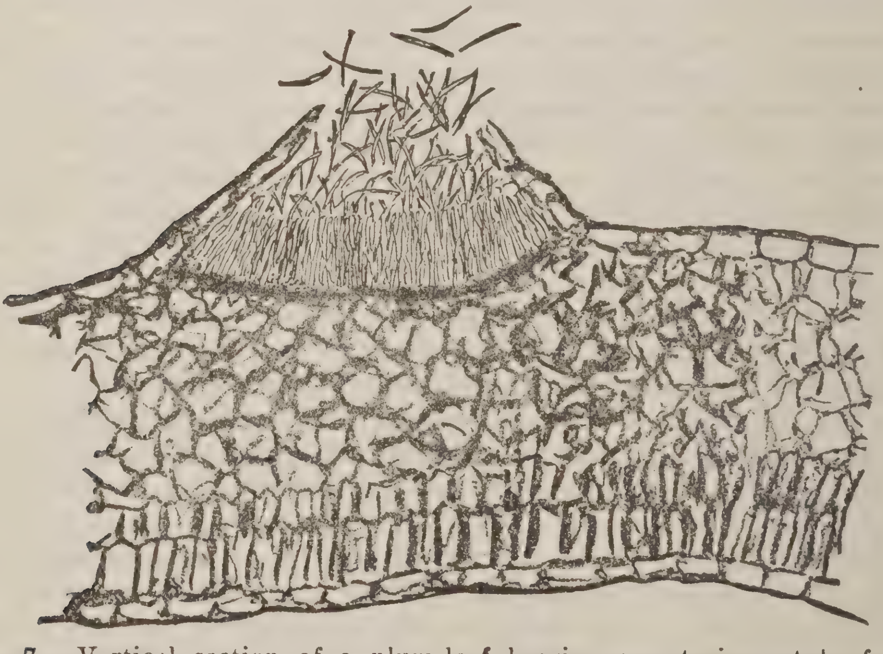

Fig. 7.—Vertical section of a plum leaf bearing a septoria pustule, from which the spores are escaping. The discoloration of the tissues of the leaf by the fungus extends to the opposite surface, and joins the healthy tissues on the right in a well marked line. Magnified 150 diameters. Original.

build up its own structure, and it weakens or destroys a part of the leaf tissue. The effect in part is shown in the premature ripening and loss of the foliage. On young trees the leaves often begin to fall by the first of August, and frequently by the latter part of the month very few, except some of the youngest at the ends of the branches, remain on the tree. The early loss of foliage tells upon the vigor of the tree, and seriously interferes with the annual growth; at the same time the tree is ill prepared to withstand the rigors of winter, and starts into leaf the next spring with diminished vitality. According to Mr. T. T. Lyon,[1] the well known fruit grower of Michigan, all varieties are not attacked alike: "the Chicasaw and Americana classes are nearly or quite exempt, while many of the Domesticas, such as Bradshaw, Damson, Bavay, are far less liable to such attacks than Washington, Green Gage, Jefferson and numerous others." Still he thinks that "the disease is a very serious one."

If we turn to find some means for checking or preventing the growth of this fungus, it becomes at once apparent, that so far as our present resources go, no topical application is likely to be efficacious, from the fact that it is not a superficial parasite, but an internal one. Some indirect method of fighting it must therefore be devised; for this purpose a knowledge of the transformations and habits of the fungus is evidently of primary importance. To this end a study of its life history has been carried on for two years past, but up to the present time, it is to be regretted, without complete success.

First, directing attention to the manner in which the fungus passes the winter, it is found that the septoria spores (shown in Fig. 6) cease to be formed with the death of the leaf, and are replaced by another kind, which considered independently would be referred to the genus Phoma. The latter are minute, colorless, nearly globular spores, formed in the greatest abundance at the ends of crowded vertical threads lining a cavity (Fig. 8). The external appearance is that of black pustules which are borne on the same spots that bore the septoria, and in equal abundance. Like the septoria, the phoma only fruits upon the under

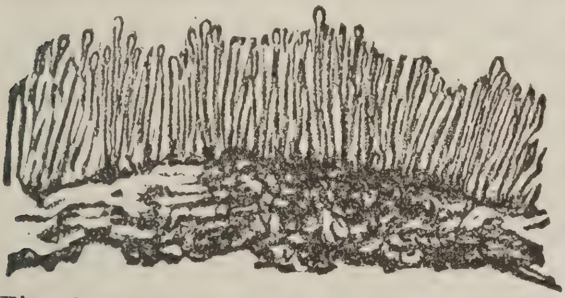

Fig. 8.—Part of the spore-bearing layer lining a phoma pustule; from a plum leaf gathered in September. Magnified 430 diameters. Original.

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[1] Mich. Horticulturist, Vol. I, 1886, p. 134.

surface of the leaf, and the growth appears to be entirely arrested when this surface is in contact with the soil. It might be expected that under such circumstances the pustules would appear upon the exposed upper surface of the leaf as it lies upon the ground, but such is not the case; the upper surface remains as free from the phoma as if the leaf did not contain the mycelium of it. Further investigation may show that when this surface is continuously covered until the decay of the leaf, the fungus also dies without leaving spores for its future propagation; but it has not yet been proven. The phoma makes a slow growth throughout the winter, and may be found as late in the following spring as May. When warm weather comes the black pustules begin the formation of another set of spores very different from the former kinds. These are quite large, oblong in shape, and contained in elongated sacs or asci; in short they are the ascospores of a mature form of an ascomycetous fungus. By the first of May the asci or sacs are well developed, but the spores inside of them have barely become defined (Fig. 9), and some weeks longer are needed to develop and finally bring them to a sufficient state of ripeness for distribution, and a renewal of growth when conditions become favorable. There are thus three sets of spores produced by the fungus at different seasons of the year —the septoria spores in summer, the phoma spores in winter, and the ascospores in spring.

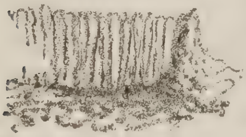

Fig. 9.—Section showing the asci at the time the spores begin to form. Magnified 120 diameters. Original.

But at this point some critical reader may wish to inquire what reasons there are for believing that these very different kinds of spores are really produced by the same fungus. There are several very good ones. The resemblance which these successive forms bear to the course of development in other ascomycetous fungi, in which the life history has been well established, is strong presumptive evidence. To this is added the fact that the three stages overlap one another, that is, the phoma begins upon the same spots occupied by the septoria, and often before the latter has ceased producing its spores, while the ascosporous condition in the same way follows the phoma, and this succession is invariable. A further point of evidence is that the phoma is in the same relative abundance as the septoria, and always follows it, while the same is apparently true of the ascosporous form in its relation to the phoma, although, from accidental causes, this has not been so fully observed. Until some proof can be adduced to the contrary, therefore, we shall be warranted in assuming that the three forms described are but developmental states of one fungus.

It is reasonable to suppose that the three sorts of spores have three diverse and important offices to perform. As to the ascospores, there can be no doubt that they germinate upon the leaves of the plum tree in spring and start the new growth that sometime afterward bears the septoria spores. The phoma or winter spores may be of sexual nature, and perform the office of the male element in originating the ascophorous stage of development, but this is conjecture based only on the time and mode of occurrence. It seems probable that the septoria spores are for the immediate and rapid distribution of the fungus to all suitable surfaces for its growth in the vicinity. If so the spores ought to germinate with readiness, but several attempts have proved unavailing when they were sown upon or in water. Some other method of germination, however, may bring better success.

In the light of the present knowledge of its life history, two reciprocating methods of combatting the fungus seem to commend themselves. Bury or burn the fallen leaves before the first of the next May, to prevent the fungus from surviving the winter and germinating in the spring, and then spray the foliage during May and June, or even longer, with some fungicide to prevent stray spores from starting the fungus in the leaves. If it is too much trouble to gather and burn the leaves, much may evidently be accomplished by plowing them under in late fall or early spring. It is impossible to say what fungicides will prove efficient, as none have been tried, but a solution of hyposulphite of soda or sulphide of potassium will probably serve as well for trial as any. The application should be renewed after showers have washed off the preceding one.

So far as now known this fungus is confined to America. It was described in 1876 by Mr. Chas. H. Peck,[1] who gathered it in the Adirondack mountains on the leaves of the wild black cherry. A very similar species, if not identically the same, has been described by Mr. Ellis[2] on leaves of the wild plum (Prunus Americana) received from Kentucky in 1882. These descriptions do not apply to the ascophorous or perfect form of the fungus, which does not appear to have yet been named. A full knowledge of the development will eventually necessitate throwing the fungus into another genus.

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[1] 29th Rep. N. Y. State Museum, p. 48.

[2] Amer. Naturalist, Vol. XVI, 1882, p. 811; Ellis' N. Amer. Fungi, No. 1151. The length of the spores as given by Ellis, is 30 to 50 mu, and by Peck, .002 to .003 inches=50 to 75 mu, while my own measurements of similar material to that used by Peck give 35 to 60 mu. My examination of a large amount of material gathered from different varieties of plum, cherry, apricot, and peach, at different times in summer and fall, leads me to think that these differences of measurement are sufficiently explained by the variable vigor in the growth of the fungus at different times and on different hosts, which to a considerable extent influences the size of the spores, as it also does the appearance of the spots. Aside from the size of the spores, the only material distinction between the two, according to the descriptions, is that S. Pruni is said to have 4 to 6-septate spores. But an examination of the specimens in N. Am. Fungi shows the spores to be simple, as in S. cerasina, and the contrary statement is possibly due to an error. From this examination of material and literature it seems safe to consider **S. Pruni** a synonym of S. cerasina.

Upon the wild cherry it produces little injury. On the cultivated cherry the injury is more considerable, but not often serious, so far as observed. The apricot and peach are also slightly affected. On the latter the fungus rarely produces many septoria spores, but after growing awhile, the tissues of the leaf containing the parasite become dry, separate perfectly from the surrounding healthy tissue, and drop out, leaving a round hole as cleanly cut as if made artificially. The appearance in peaches and apricots is known as the gun-shot injury in California, where it is so abundant as to be detrimental, but whether caused by Septoria cerasina, or not, is not known to the writer. In plums (Fig. 10) the gun-shot holes are sometimes numerous, and sometimes quite absent. The causes which determine the fall or retention of the spots has not been made out.

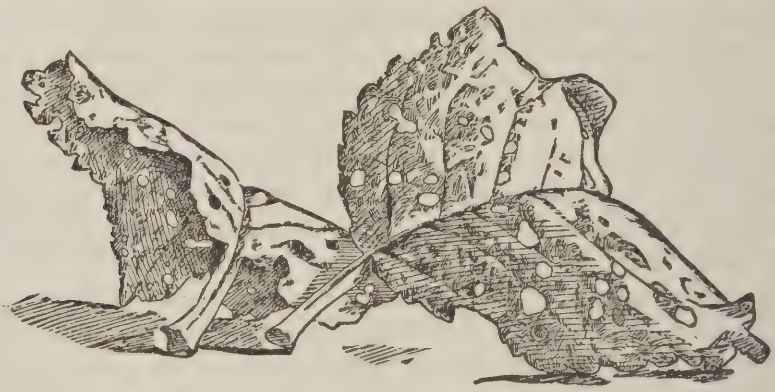

Fig. 10.—Leaves of cultivated plum perforated by Septoria cerasina. Original.

WEED STATISTICS.

The observations on the number of weeds found upon one-twentieth of an acre during a growing season have been continued. The plat selected this year was some distance from the one used last year, and both were originally part of the same abandoned pasture. This one had been ploughed in 1882, and had borne four crops, with an annual dressing of commercial fertilizer, and without stable manure. The land on all sides has had constantly clean cultivation.

The countings were made in June, July, August and September, the largest weeds being pulled up and removed each time, leaving the smaller ones to grow. The accompanying table gives the result. For convenient reference the results obtained in 1885 are incorporated with those of the present year.

WEEDS GROWING ON ONE-TWENTIETH OF AN ACRE.

ENGLISH NAME.	LATIN NAME.	1885.	1886.
Three-seeded Mercury	Acalypha Virginica L	2	18
Couch-grass	Agropyrum repens B	—	46
Virginian Anemone	Anemone Virginiana L	1	—
Pigweed	Amarantus albus	—	2
Redroot	Amarantus retroflexus L	4	134
Ragweed	Ambrosia artemisiæfolia L	62	48
Ragweed	Ambrosia trifida L	68	—
Burdock	Arctium Lappa L	1	—
Milkweed	Asclepias Cornuti Dec	67	—
New England Aster	Aster Novæ-Angliæ L	3	—
Shepherd's Purse	Capsella Bursa-pastoris M	2	18
Mouse-ear Chickweed	Cerastium vulgatum L	—	3
Pigweed	Chenopodium album L	21	400
Ox-eye Daisy	Chrysanthemum Leucanthemum L	3	—
Canada Thistle	Cnicus arvensis Hoffm	4380	8
Common Thistle	Cnicus lanceolatus Hoffm	3	—
Spurge	Euphorbia maculata L	69	3
Sunflower	Helianthus annuus L	—	40
St. John's-wort	Hypericum multilum L	1	—
Wild Lettuce	Lactuca Canadensis L	1	—
Tomato	Lycopersicum esculentum Mill	—	1
Catnip	Nepeta Cataria L	2	—
Wood Sorrel	Oxalis corniculata L., var	62	1
Witch Grass	Panicum capillare L	123	12
Barn-yard Grass	Panicum Crus-galli L	11	10
Low Finger-grass	Panicum glabrum Gaud	516	4
Common Parsnip	Pastinaca sativa L	3	—
Timothy	Phleum pratense L	27	—
Ground Cherry	Physalis Virginiana Mill	—	1
English Plantain	Plantago lanceolata L	162	1
Common Plantain	Plantago major L	10	4
Common Plantain	Plantago Rugellii Dec	1	21
Kentucky Blue-grass	Poa pratensis L	194	—
Fowl Meadow-grass	Poa serotina Ehr	—	4
Smartweed	Polygonum acre H. B. K	14	—
Knotgrass	Polygonum aviculare L	7	21
Black Bindweed	Polygonum Convolvulus L	12	81
Smartweed	Polygonum Pennsylvanica L	2	—
Lady's Thumb	Polygonum Persicaria L	120	831
Purslane	Portulaca oleracea L	—	6
Smooth Sumach	Rhus glabra L	1	1
Red Raspberry	Rubus strigosus Mx	5	—
Sheep Sorrel	Rumex Acetosella L	20	—
Curled Dock	Rumex crispus L	3	—
Red Dock	Rumex sanguineus L	14	—
Groundsel	Senecio vulgaris L	—	2
Foxtail Grass	Setaria glauca Beauv	2233	133
Pigeon Grass	Setaria viridis Beauv	420	1810
Golden Rod	Solidago Canadensis L	4	—
Sow Thistle	Sonchus asper Vill	—	3
Sow Thistle	Sonchus oleracea L	1	—
Sorghum	Sorghum vulgare L	—	173
Common Chickweed	Stellaria media Smith	—	1
Dandelion	Taraxacum officinale W	129	6
Red Clover	Trifolium pratense L	4	122
Yellow Clover	Trifolium procumbens L	1	—
White Clover	Trifolium repens L	37	122
Mullein	Verbascum Thapsus L	—	3
Speedwell	Veronica peregrina L	—	1
		8726	4095

It will be seen by the table that twenty-three species occurred in both years, aggregating, after deducting the

Canada thistles, 4008 individuals for 1885 and 3801 for 1886. Twenty-two species of 1885 numbering 438 individuals did not appear in the plat of this year, while fourteen species with 286 individuals occurred this year and not last. The majority of the species peculiar to last year are to be classed among the weeds most commonly met with in borders of cultivated fields and in pastures and meadows, while those occurring only this year are more characteristic of continuously ploughed fields.

The present year's observations very well represent the condition of clean cultivation of unmanured land, which has been ploughed long enough to eradicate most weeds, adventitious from its condition as a meadow or pasture, and not long enough to become infested with those from old cultivated fields. This is practically the minimum number of weeds for ordinary cultivation, and amounts to 81900 individuals per acre for the growing season.

IMPORTANT ARTICLES ON PEAR BLIGHT.

The following list of papers, selected from several hundred titles forming part of an index to the subject, in course of preparation by the writer, is intended to indicate the prevailing public opinion upon the subject of pear blight from the earliest record yet found to the present time. As the index from which it is taken is yet far from complete, it is likely there are other papers that might have been advantageously added, although the object in presenting it at this time is well attained as it stands.

Brief abstracts of the papers are appended, giving much valuable information, but also exhibiting some errors of opinion and observation, which the reader will doubtless easily detect. It should be said in justice to the authors quoted, that the selections do not in every case represent mature opinions, but rather those standing for the foremost thought of the time, or made prominent by the position of the writer, or the time or the place of utterance, which subseqent information may have materially changed.

The early accounts are especially important in studying the history of the origin and spread of the disease, and any information regarding items or papers printed in the last century will be very welcome.

1794. **Denning, William.** On the decay of apple trees. Trans. Soc. for Prom. of Agric., pt. 2, 1794, p. 219. [3½ pages.]

Same, 2nd ed., vol. I, p. 185.

This is from a letter writen Dec. 22, 1793. He first saw the malady on the Highlands of the Hudson in 1780. It also attacks pears and quinces. He describes it fairly well, but refers it to a borer in the trunk, which he found after much labor.

1817. **Coxe, William.** Cultivation of fruit trees, 1817, p. 174. [1½ pages on blight.]

"That species of blight which is sometimes called the fire blight, frequently destroys trees in the fullest apparent vigour and health, in a few hours, turning the leaves suddenly brown, as if they had passed through a hot flame, and causing a morbid matter to exude from the pores of the bark, of a black ferruginous appearance; this happens through the whole course of the warm season—more frequently in weather both hot and moist. It generally, though not always, is perceived most in confined places; certain kinds and particularly that most exquisite of winter pears, the St. Germain, seems peculiarly liable to this species of blight. I have in twenty years lost upward of fifty trees in the fullness of vigour sometimes in the most open airy situations, and in every kind of soil." Old varieties supposed to be more subject to the disease, the "Seckle," a new variety, not often having it. "From the great vigour and rapidity of the vegetation in America, pear trees, if much pruned, are apt to grow too fast; this appears to render them more liable to the effect of the fire blight than otherwise they would be." The influence of the hot sun and other causes spoken of; light pruning recommended.

(This is said to be the oldest American book upon fruit culture.)

1826. **Lowell, John.** New England Farmer, vol. v, July 28, 1826.

Describes the work of Scolytus pyri in killing the limb, as if it had been cut off and thrown aside to dry. Notes finding the insect, and transmitting it to Prof. Peck, who first described it.

1843. **Fessenden, Thomas G.** New American Gardener, 1843, p. 245. [1 page on blight.]

Said to be due to Scolytus pyri, to overpowering rays of the sun, to plethora or surfeit brought on by too high manuring or too much pruning. Only remedy is to saw off the affected limbs "some inches below where the blight appears."

1844. **Beecher, Rev. H. W.** (Indiana). The blight in the pear tree; its cause and a remedy for it. Mag. Hort., vol. x, 1844, p. 441. [15 pages.]

Describes blight as known in the Western States. Before the leaves appear the bark of the last year is found dead and dry in spots, or else puffed and soft with thickened sap—only different degrees of progress in the same disease. The former permits the branch to put forth leaves, but dies the coming winter; the latter engenders active disease. Disease starts in the ends of shoots and progresses downwards; from the time of first appearance to the death of the part is from a few hours to three weeks. Wood turns brown, the sap is thick and unctious, with a sour odor like fermented watermelon, or tops of potato vines after being frosted. The odor may be perceived at some distance from the trees. Bark sometimes bursts and acrid sap exudes, which destroys vegetation on which it drops. This is called the true winter blight; summer blight only injures the leaves.

Theories:—1, rays of the sun passing through vapors; 2, poor or deleterious soil; 3. violent changes of the temperature of the air, or of the moisture in the soil, sudden change from sward to high tillage, resulting in "surfeit" or "overplus" of sap; 4, stimulation by high manuring or constant tillage; 5, effects of age—old varieties being most subject to it; 6, attacks of insects—Scolytus pyri, aphides, etc.

Cause of blight:—Autumn freezing of unripe wood, which engenders a poison that destroys the shoots and branches in the following season. This is elaborated in extenso.

Proofs of the theory are: 1. The two great blight years of Indiana were 1832 and 1844, and they were preceded by early and severe autumn freezing. 2. It may be predicted the winter before its occurrence by experienced nurserymen, in individual trees or limbs. 3. Late winter or early spring pruning shows a viscid sap in affected limbs. 4. Trees which ripen their leaves and wood early are least affected. 5. Wherever artificial causes have either produced or prevented a growth so late as to be overtaken by a freeze, blight has, respectively, been felt or avoided. 6. An orchard favorably situated to ripen its wood early in 1843 had no blight in 1844, while all about it had. 7. The fact that blight first appears low down on branches is no objection, as that is where the returning sap "effects a lodgment." 8. Spring frosts do not produce it, for in 1834 they were severe in May, and no blight followed. 9. Forest trees do not suffer much because protected by one another. 10. Fall-growing shrubs may not be as susceptible to injuries by freezing. 11. Spring-grafted shoots get their blight from the stock which has been exposed to the winter. 12. Spread of the disease through the tree is due to the malignant sap where killed by freezing. 13. Trees of vigorous constitution are sometimes able to throw off the disease. 14. Rich and dry soil gives vigor and prevents blight; rich and moist soil forces growth and prepares for blight.

Remedy: 1. Light, rich and dry soil. 2. Varieties that early ripen their wood. 3. Root-pruning when in danger of late fall growth. 4. When it has occurred resort to "free and early cutting."

Additional items: This blight is not to be confounded with winter killing. The "Yellows" is believed to be a "development of the blight according to the peculiar habits of the peach tree."

1845. Downing, A. J. Fruits and fruit trees of America, 1845, p. 322. [6½ pages on blight.]

Same, rev. by Chas. Downing, 1857, p. 412. [6½ pages.]

Same, 2nd rev. by Chas. Downing, 1885, p. 644. [5⅓ pages.]

"This disease has been, at different times, the terror and despair of pear growers." Has been known for nearly a hundred years, but notions of its character and origin have been so vague as to lead to few practical means for controlling it. A page is given to the insect blight and remedy, caused by Scolytus pyri.

Fire blight is treated under the heading of "frozen-sap blight." Symptoms are (1) a thick, clammy sap at winter or spring pruning, (2) dead patches of bark on trunk or large branches seen in spring, and (3) rather sudden dying of extremities in early summer. In severe cases it may extend throughout the tree. This is explained by saying that early autumn freezing changes and poisons the sap, and the poison is distributed by the movement of sap in spring. In support of this theory it is pointed out that those varieties ripening their wood early in autumn, like the Seckel, are least affected.

Preventive measures are to avoid wet and unduly enriched soils, late summer pruning, and those varieties which ripen their wood late. When late growth cannot be avoided resort to root pruning and apply lime. Cut away all diseased branches as soon as seen.

1846. EATON, L. C. (Providence, R. I.) Review of opinions on pear tree blight. Hort., vol. I, 1846, pp. 459, 495. [4⅛ + 5 pages.]

Distinguishes between the true pear blight and that caused by the insect, Scolytus, then examines the theories which ascribe the former (a) to electricity and atmospheric influence, (b) to old age or long duration of varieties, (c) to a sudden freezing of the bark, and (d) to an epidemic transmitted by the air.

Judge Buel in 1828 in the New England Farmer, and the editor of the Genesee Farmer in 1833, championed the insect theory. In the New England Farmer for 1829 a correspôndent ably answers Judge Buel, and argues that electricity and rarification of the air produce blight. Forsyth and Prince ascribe it to sun-stroke. Coxe, following European thought, favored the view that it is connected with the enfeebling of varieties by age. If it were an epidemic or in any way related to Asiatic cholera, the whole tree and all varieties would be alike affected. These several theories are carefully treated, their weak points displayed, and additional facts supplied. The frozen sap theory of Downing is finally thought to best accord with the facts. Careful examination of his own orchard before leaves appeared in spring convinced him that the injury which becomes conspicuous in June is really begun in the winter. Late succulent growth is to be avoided ; pears worked on quince, and root pruning for rich soils, are advocated.

1846. G[OOKINS], S. B. (Terre Haute, Ind.), and A. J. Downing. Remarks on the pear blight of the west. Hort., vol. I, 1846, p. 253. [3 pages.]

Does not agree with Mr. Beecher regarding the cause. May 10th, 1834 was a very severe frost, killing fruit buds of forest and fruit trees alike, yet it was not followed by blight. Other like instances given. An objection to the theory is that old trees are attacked rather than young ones. Another objection is that freezing does not change the sap to render it poisonous; death by freezing is not occasioned by deleterious properties imparted to the sap; the small branches of the trees freeze every winter. Yet blight is evidently a "disease of the circulation," as proved by the following instance. Visiting Mr. Ragan in 1845, he was shown a thrifty young pear tree in the nursery, which had been "inoculated by way of experiment" with "the sap of a blighted tree" "a few days previous." "He had made an incision about three feet from the ground, lifted the bark as in the process of budding, and injected a small quantity of the diseased sap." "We found the leaves of the patient changing color, and emitting that peculiar odor which indicates the incipient state of decay, which is always present in cases of blight, and upon applying the knife, the inner bark was found to be black from the root to the top, while nothing of the kind appeared elsewhere in the nursery."

Objects to whitewashing as a preventive, as the disease "is contracted at the extremities," which is not touched by the whitewash.

"I strongly incline to the belief that the pear blight is an epidemic; that it prevails like other epidemics, and will pass off like them. The atmosphere is, I believe, generally admitted to be the medium by which they prevail, and are carried from place to place. What that subtile principle may be, which pervades our atmosphere, by which infection is retained and transmitted, so that, like the Asiatic cholera, it makes the whole circuit of our earth, human science has not discovered; but that such a principal exists is sufficiently obvious from its effects." There is "good reason to believe the vegetable world may be affected in like manner" with the animal.

To this A. J. Downing appends an editorial note in which he states that the theory of Mr. Gookins of "an epidemic conveyed by the atmosphere" is "too slightly supported by facts to weigh at all against the observations made by cultivators," all of which "strongly points to the freezing of the sap as the cause." "Were the cause atmospheric, its effects would always be seen first at the points of the shoots." "Its first symptoms also would always develop themselves in the growing season." On the contrary, the first symptoms of the frozen-sap blight are the black spots on the bark of the limbs or trunk, a long way from the extremities, and first seen in late autumn, winter or early spring. Repeats advice to prevent injury by whitewashing the trees.

1847. BARRY, PATRICK. (Rochester, N. Y.) [Editorial comment.] Genesee Farmer, vol. VIII, 1847, p. 218. [2 col.]

"Insect blight" is more prevalent in some sections of the country this season than it has been for the last seven years. Apple, pear, quince, crab, and even the walnut and hickory have all suffered. First noticed in the latter part of may, as the apple was passing out of bloom. Last of July it is not abated. Generally called "fire blight," but believed by the writer to be solely due to an insect that is venomous to the tree. Fruit spurs on apple and pear attacked, afterward the extremities of the young newly formed wood. If cut away below the affected part, it is arrested. In apple and quince it proceeds but a foot or so below the point attacked, but in pear passes downward rapidly until the tree is dead. This is like the "frozen-sap blight," so much talked of at the West. Sap becomes brown and thick, the bark cracks and blackens and turns hard as iron. Attacks healthy trees on dry land, noticeably fruiting trees largely, including Seckel. Other reasons are given for believing it due to an insect, but not to Scolytus pyri, yet the writer has found no track of the insect even with a lens.

1848. ERNST, A. H. (Cincinnati, O.), and A. J. Downing. On the fire blight in pear trees [with comments]. Hort., vol. II, 1848, p. 328. [3¼ pages.]

Lowell's insect theory and Downing's frozen-sap theory are thought inadequate, and ascribes it to the heat of the sun, assisted by rain drops acting as lenses. The effect is to "scald the sap, burst their vessels, and produce precisely the same results that a scorching fire would." The argument is well presented. The remedies suggested are to select varieties with wood "of a compact texture and slow of growth," like the Seckel, and give northern exposure. The editor, A. J. Downing, believes this explanation correct for certain forms of blight, other forms are produced by insects, and others still by freezing.

1848. HARRIS, T. W. (Cambridge, Mass.), and A. J. Downing. On the blights of the pear tree [with comments]. Hort., vol. II, 1848, p. 365. [2¼ pages.]

A strong argument, to show that the insect blight, produced by Scolytus pyri, which does not seem to be known in the Western states, is entirely distinct from other blight. The Scolytus lays eggs in the buds of healthy branches about a year before the blighting effects are produced, while according to the theories of Downing and Ernst, the other blights do not start earlier than the previous winter, and it is absurd to think that the insect could foresee which limbs were to be affected by freezing or hot sun. Mr. Downing, the editor, commends the article, and says "there is no vegetable malady in which the cultivator of fruit trees in America is so much interested at present as the pear tree blight."

1848. WENDELL, H. (Albany, N. Y.), and A. J. Downing. Whitewash versus pear blight [with comments]. Hort., vol. II, 1848, p. 339. [1¼ page.]

Washed his trees in the previous fall with lime, as recommended by the editor, but has lost fifteen trees from blight, affecting the trunks, although had never before lost a tree from this disease. Thinks this shows it is not a preventive of blight, and that it tends to disprove the theory of scalding by sun. The editor, A. J. Downing, suggests that the pear blight might not have been due to freezing but have come by the sun's rays acting in summer on spots where the lime had been washed off by the showers, and suggests adding some sizing to prevent this. He quotes from a recent issue of the "Revue Horticole" of Paris, an account by M. Bravy, of *chancre* in apples and pears, much like blight, which he explains as Mr. Ernst (l. c., p. 328) does, and urges the use of whitewash. Mr. Downing meets objections to the efficacy of this wash by an experiment performed in December, at the same time bringing to mind that it is not the freezing, but the sudden thawing that produces the mischief. The bulb of a thermometer was whitewashed and hung by an uncoated one. The former registered 79° with the latter at 97°, when exposed to full rays of the sun, showing that "even in a winter's day," a coating of whitewash keeps the temperature "from rising as high as it would do by 20° or more."

1849. JACQUES, GEORGE. Practical treatise on fruit trees, 1849, p. 201. [1½ pages on blight.]

Probably three sources of blight in pear: an insect causing insect blight; changes of winter weather causing winter blight; and "rays of the sun" causing sun blight. It has done "comparatively little mischief in New England states."

1849. JAMES, J. H. (Urbana, O.) Blight in pear trees. Mag. of Hort., vol. XV, 1849, p. 13. [10 pages.]

Dissents from the opinion that there is any difference between the blight of the east and west. He describes the disease as a "putrid fermentation having the smell of a spoiled watermelon." The change is equivalent to complete destruction of the tissues surrounding the wood. He sent a letter dated July 12, 1844, to the Cincinnati Horticultural Society, published in Western Farmer and Gardener, Aug. 1844, the essential parts of which were given in Mr. Beecher's essay (l. c.), in which he suggests that it is due to "fermentation of the sap," not caused by the brown aphis, as Dr. Mosher thinks (in paper read before the Cincinnati Hort. Soc.). "The most thrifty and succulent kinds are apt to be attacked with the blight." He at this time also suggested that it might be caused by an undue amount of sap in the branches, brought to decay by sudden alternations of heat and cold. This does not differ from Mr. Beecher's view, except that he thought that the harm was done in the autumn instead of in the spring. He is now of opinion, however, that the injury is incurred in winter instead of spring, and recites instances to support this view.

Dissents from Mr. Downing's views on insect blight (which seem to be mostly taken from Lowell's account). He thinks Mr. Downing's statement that the sap becomes poisoned must be only conjecture, for it seems "that the sap, after fermentation, was no longer transmissible, and soon dried up." "Grafts taken from a blighted top, will grow into healthy branches, as I have seen." "The injury may be regarded as entirely local."

Suggests planting in the lightest soil that the nature of each kind will bear; seeking hardy kinds that make slow growth and ripen their wood well; growing thrifty kinds on slow-growing stocks.

1849. THOMAS, JOHN J. American Fruit Culturist, 1849, p. 201. [2½ pages on blight.]

Same, 1867, p. 157. [2½ pages.]

Same, 1875, p. 157. [2½ pages.]

Same, 1885, p. 163. [2½ pages.]

This disease is variously called fire-blight, insect-blight, frost-blight, and frozen-sap-blight. In all forms "the appearances are the same—a sudden withering and turning black of the leaves on certain limbs during rapid growth, and while the rest of the tree remains apparently in full vigor, the evil extending downwards, unless naturally or artificially checked, till the whole tree is destroyed." The several hypotheses to explain the cause are detailed—the heat of the sun's rays, the insect Scolytus, and the frozen-sap theory—and the conclusion arrived at that the real cause is not known. The remedy is not so uncertain; it is to immediately cut away the dead branches and burn them. "And, as the poison passes downwards some time before its effects are visible externally, the amputation must be made two or three feet below the affected part." Cutting down trees not over ten years old to within two feet of the ground as soon as the blight appears in them, has been very satisfactory. Among preventives, the early and full ripening of the wood in autumn is most important. The Seckel is the variety least affected by blight. Blight in the apple and quince "rarely proves a formidable disaster."

1850. KENNICOTT, J. A. (Northfield, Ill.) Observations on pomology. Rep. Ohio Agric. for 1850, p. 464. [2⅓ pages on blight.]

Same in Proc. Am. Pom. Soc. for 1850, p. 48. [3 pages.]

He made careful observations upon the disease as it appeared in his own garden, and as seen elsewhere. It was especially prevalent and severe throughout Illinois in 1850. He noticed it first in quince trees about the middle of June. They had been heavily loaded with flowers, and the disease first showed by the sets withering, and in a few days the extremities were blighted. The dead twigs were removed with a knife, but upon examination in July the disease still showed. A few apple trees were affected about the first of August, and two pear trees. All these were in one corner of the garden which had been highly manured and cultivated, while the rest had not.

In passing through the State he found the popular opinion to be that the disease was caused by insects. He therefore looked closely for insects, and, as "doctors are famous for finding what they look for in post mortem examinations," he found insects. The conclusion of his study, however, was that the insects (larvæ) which killed the twigs did not produce genuine blight, and those which did not kill them had nothing to do with the disease.

He thinks high cultivation favors the disease. "I think it is a true epidemic which attacks, as in animals, the grossest feeders and enfeebled constitutions, in preference to the hardy and temperate subjects." "If left to itself a line of demarcation is formsd and a separation of the living and dead parts ensues." He is in doubt, judging from his observation, whether it is the same disease as occurs in Ohio and New York, where the trunks and limbs of the trees are usually first affected, instead of the ends of the shoots.

1854. Ernst, A. H. (Cincinnati, O.) Pear blight. Horticultural Review, vol. ix, 1854, p. 170. [8½ col.]

He does not think blight to any large extent is due to insects or exhaustion of the soil, but rather to sudden changes, or winter temperature, or "excessive summer sun." Former often slow in action, but the latter "generally rapid and instantaneous." The sap is "scalded and vitiated, a chemical process of decomposition takes place, its poison is soon carried to and mixed with other portions of the tree." The only remedy is to lop off until sound wood is reached, and thus prevent the disease spreading. It should be called sun blight, or fire blight. Prevention is to shorten in the present year's growth toward the end of the season, and compel full ripening of wood. Hardy new varieties from seedling stock recommended as better able to withstand blight.

1856. White, William N. (Georgia.) Gardening for the South, 1856, p. 360. [2 pages on blight.]

"Causes not known." Lowell and Turner's insect hypothesis not deemed to be sufficient to cover all cases. Van Buren, "one of our best pomologists," ascribes it to an insect, puncturing the trunk and larger limbs. In all forms of blight, cut away the diseased part. "Examine daily" and "cut promptly." Best preventive is not to feed too highly with "nitrogenous manures."

1863. Salisbury, J. H. and C. B. Apple blight. Rep. Ohio Agric. for 1863, pp. 450, 469. [8½ pages.]

In 1862 the blight began to affect apple, pear and quince trees in central Ohio about June 12, and was active about a month. The fungi found in connection with the blight at this time are described at length, and abundantly but crudely illustrated. They belong to various species common upon dead or dying limbs—Oidium fructigenum, Macrosporium sp., etc., together with debris from the tissues. These are all referred to one species and the name, Sphærotheca Pyrus, Salisb., given to it. The fungi are believed to emanate from low wet ground, from which the spores rise into the air and attack the trees. This is spoken of as a discovery of the cause of blight.

In 1863 the blight appeared in central Ohio on May 31, during warm weather, but made slow progress in the following month, owing to dry weather.

1866. Meehan, Thomas. (Germantown, Pa.) Diseases of the pear. Gard. Monthly, vol. viii, 1866, p. 77. [2 col. on blight.]

Fire blight is divided into two classes: (a) insect blight, (b) frozen-sap blight. The insect blight occurs in June and July; it is not common. Frozen-sap blight is made synonymous with fire blight. The branches "die away as suddenly as if they had been stricken by fire." No worse now than it was "a hundred years ago." Suspects it is in some way connected with freezing in winter, but has no proof, except analogy with roses, which leave out in spring but die in June and July suddenly, and have a black dead pith. But in roses it is last year's shoots that die, while in pears it is limbs, four, five or more years old, which are stricken, followed by the younger portions. Thinks that microscopic examination might show the cells weakened by frost or other injury, and the presence of fungi, whose spores are always ready to develop in proper nidus. But the frost theory is weakened by the fact that trees on high well-drained soil often blight worse than in low damp situations. Trees otherwise perfectly healthy blight badly

1867. MEEHAN, T. (Germantown, Pa.), and others. Diseases of the pear [with discussion.] Proc. Am. Pom. Soc. for 1867, p. 57. [6 pages on blight.]

Same (without discussion) in Trans. Ill. Hort. Soc. for 1867 (in Ill. Dep. Agric., vol. VII), p, 502. [2 pages.]

The insect blight is due to the Scolytus pyri. Frozen sap blight is due to the inability of the plant to maintain, at any certain spot, "heat enough to maintain life," which occurs whenever the evaporation exceeds the supply of moisture. This takes place when the ground is frozen. Fire blight proper is far the most injurious. "Here, I am satisfied, we have to deal with a parasitic fungus." It grows in the bark, "causing fermentation," and when it girdles the limb, the sap is prevented from rising and the part above dies "as if cut away or thrown into the fire." He aims a blow at the fallacy that "fungi only attack diseased vegetation." Remedy is to cut and burn the diseased parts in order to stop the spread of the fungus spores.

Dr. H. Claggett (St. Louis, Mo.) saved trees by shaving off the diseased bark. He thinks it due in dwarfs to "want of affinity between the pear and the quince." A neighbor of his "believes he has found a night moth which does this work." P. Barry (Rochester, N. Y.) said: "I confess I have nothing to say except what is pure speculation; and I have got tired of speculation, and of hearing it on this subject." Excision the true remedy. "I do not believe it to be caused by an insect." G. Husman (Herman, Mo.) had abandoned high manuring, and cultivation late in the season. E. S. Hull (Alton, Ill.) also believed it due to a fungus. "I have inoculated trees with it." Recommends and explains root pruning as a preventive. F. R. Elliott (Ohio) has faith in copperas water, as recommended by Dr. Kirtland.

1867. WARDER, JOHN A. American Pomology, 1867, p. 174. [9 pages on blight.]

Frozen-sap, fungous and insect theories alike unproven. No proof that poisons are produced in the limbs. Treatment necessarily unsatisfactory. Checking annual growth can be done by root pruning in spring. Speaks of a "blight" of apples and quinces confined to the twigs; cause obscure, but may be due to atmospheric influences. The true apple blight much resembles fire blight. Quotes from Dr. Kirtland's address to the Ohio Pomological Society to the effect that early in this century it was a popular opinion that blight and some other diseases of plants, together with spotted fever and similar epidemic diseases of the human family, "arose from one cause," a view not, however, concurred in by medical and scientific men of that day. Insects, frozen sap, electricity, excessive evaporation, and exhaustion of soil, alike unsatisfactory. Suggests that it is due to the "poisonous impression of the seeds (sporules) of a microscopic fungus," and suggests copperas as a remedy. This is to be applied by washing the bodies of the trees with a saturated solution either before or after the blight begins to show. Might be put on with a syringe. Placing scales of iron about the tree thought to be good. Salisbury's views referred to as confirming this fungous theory.

1868. Hull, E. S, (Alton, Ill.) Cryptogamous diseases, and root-pruning the pear—a preventive of blight. Trans. Ill. Hort. Soc. for 1868, p. 35. [2⅓ pages.]

Same in part in Rep. Ind. Hort. Soc. for 1870, p. 42. [2 pages.]

"Blight is induced by an extremely minute fungus." The spores of it enter the tree by the pores of the bark. It "may be collected by a damp camel's hair brush, and when macerated in water and placed in contact with the alburnum, as in budding," produces a change which leads to "fermentation in the affected part." The root-pruning remedy for blight was practiced by him "some eighteen years ago." The supposed physiological action is fully explained. Explicit directions for root-pruning are given; it is to be performed from November to April. A circular trench at least three feet deep is cut (and then refilled), eighteen inches from the trunk of a tree that is one foot in circumference, and three inches in girth. This is to be repeated once in two years, adding three inches to the diameter of the trench each time. This forces the trees "to form their terminal buds . . . by the time the blight first appears," which in that region is from May 25 to June 1.

1868. White, Wm. N. Gardening for the South, rev. ed., 1868, pp. 399, 428. [1¼ page on blight.]

"The great obstacle in pear culture is the blight, a disease whose virulence is almost peculiar to this fruit tree." The frozen sap theory cannot be true, as the sap never freezes in the warm southern climate. Different methods of cultivation do not seem to affect it. Free use of the saw and knife is the only successful remedy. "Whenever the leaves begin to wither, or the tree ceases growing, at once examine the trunk and larger limbs for the gangrened spot, which is sure to be on one or both," and when found amputate at once; "it will result in death to the tree if you let it go on." A query is raised if this disease is not inherited from the quince by working on that stock, and continuously transmitted by seeds and grafts. "The quince is subject to the blight, like the pear."

1870. Hull, E. S. (Alton, Ill.) Twig blight of the apple. Trans. Ill. Hort. Soc. for 1870, p. 220. [2 pages.]

"Several small slices of bark going deep enough to include a thin slice of wood" were taken from some diseased apple shoots sent by a correspondent (E. Daggy), and inserted into succulent pear shoots as in budding. This was done during a period of hot, but dry weather. They were not looked at till a lapse of thirty-four days, when all were found blighted, it having extended from a half to two inches above and three to fourteen inches below the wounds. The conclusion is drawn that "the fungi causing pear and apple tree blight are identical." In free growing trees twig blight often extends into the larger limbs and kills them. "There are many causes which retard blight, such as non-cultivation, drought, seeding the ground under the trees to grass, over-cropping, root-pruning, etc.; in short, anything inducing early maturity, or tending to arrest the rapid flow of sap." An instance is given of the harm done an apple orchard by too severe pruning, inducing rapid growth and great destruction from blight.

1872. Barry, Patrick. Fruit Garden, 2nd ed., 1872, p. 449. [1 page on blight.]

Same, new ed., 1883, p. 474. [1 page.]

Treated under headings: "Fire blight of pear, apple and quince," "twig blight," and "apple blight." Fire blight occurs from June to September; the sap turns brown and thick and oozes out with disagreeable odor; the branches turn black, as by fire. More destructive in pear than in the apple or quince. Only remedy is to early cut away, down to the sound wood, and burn. Twig blight attacks "young shoots of current season's growth on apple, pear, quince, mountain ash, etc." Cause not known, and injury not great. Remedy in cutting. Apple blight is like the fire blight of the pear.

1872. TAYLOR, THOMAS. (Washington, D. C.) Pear tree blight. Rep. U. S. Dep. of Agric. for 1872, p. 188. [4 pages.]

Same in Rep. Mich. Pom. Soc. for 1872, p. 587. [6 pages.]

Specious investigations on supposed connection of mold fungi with blight. Applications of sulphur, etc., thought to afford a remedy.

1875. KIRTLAND, J. P. (East Rockport, O.) Letter to Prof. Brainerd. Rep. Ohio Agric. for 1875, p. 651. [1¾ page.]

Commendation of Prof. Brainerd's paper on pear blight. He remembered a severe epidemic in Hartford, Conn., in 1812, by which many persons died suddenly, and which was coincident with an epidemic of blight. The belief prevailed that the two were due to the same cause. This belief was followed successively by the insect, frost and fungus theories, but he thinks Prof. Brainerd's explanation more plausible than any. He summarizes the best management as follows: "The cultivator must take into consideration the true character and selection of the variety of the fruit, the soil, and its condition in relation to drainage and moisture, special manures, cultivation or non-cultivation of the ground, shading and protection from the sun and from a south and southwestern exposure, mulching, freeing the bodies from old and rough bark and washing annually with a solution of soda ash, correct pruning of the season's growth in autumn, and pinching off the top of each limb before the formation of the terminal bud, late in June, and other items too numerous to mention."

1875. MEEHAN, THOMAS, and J. Gibbons Hunt. Pear blight. Gard. Monthly, vol. XVII, 1875, p. 245, [2 cols.]

Mr. Meehan's opinion that the blight is due to fungi, is confirmed by the microscopical investigations of Dr. Hunt, who believes he has demonstrated the fungus that causes the disease, but does not, however, venture to name it.

1877. CREED, WM. (Rochester, N. Y.) A few hints on pear blight. Purdy's Fruit Recorder for Nov., 1877.

Calls it "a species of vegetable ferment." First evidences of the disease are drops of sap on the surface of the branches, best seen in early morning. It follows "heavy rains and blusterous winds, accompanied by high temperature during the day and low temperature at night." This produces engorgement of sap, which bursts through at the weakest points. Fungi are secondary agents. Suggests analysis of healthy and diseased sap.

1880. BURRILL, T. J. (Urbana, Ill.) Anthrax of fruit trees; or the so-called fire blight of pear, and twig blight of apple trees. Proc. Amer. Assoc. Adv. Sci., vol. XXIX, 1880, p. 583. [14 pages.]

Same matter essentially in Amer. Nat., vol. XV, 1881, p. 527. [5 pages.]

Same matter with additions in Trans. Ill. Hort. Soc. for 1880, p. 157. [11 pages.]

Abstract in Fruit Recorder, vol. XII, 1880, p. 134. [1 col.]

Abstract in Amer. Jour. of Micr., vol. v, 1880, p. 219. [2¼ col.]

Abstract in Science, vol. I, 1880, p. 162. [1 col.]

Brief abstract in De Bary's Volesungenüber Bacterien, 1885, p. 137. [½ page.]

The fire blight of the pear and twig blight of the apple are declared to be the same, and the disease also affects the quince, butternut, Lombardy poplar, American aspen, and possibly the peach.

The destructiveness and extent of the disease are noted, and a brief account of the literature of the subject given.

Experiments in inoculation were begun July 1, 1880, using Clapp's Favorite and Bartlett pears. The first tr als were made by inserting pieces of diseased bark as in budding, but afterward the viscid exudation was thinned with a little distilled water and applied by nipping a needle or pointed knife in it and puncturing the bark, mostly in shoots of the current year's growth near their middle longitudinally, or at the apex. Ten experiments on thrifty apple trees in the last year's growth all failed. Twenty-one trials in which the virus was applied to the uninjured surface of twigs and leaves all failed. "Of inoculated pear trees sixty-three per cent. became diseased, exhibiting all the characteristics, externally and internally, of fire-blight."

Of the four quince trees all became diseased, and of the thirty-six pear trees, thirty per cent. became diseased. The virus of all was taken from the pear.

Large limbs with the disease in active progress were bound among healthy branches July 1, with favorable meteorological conditions, without result. The popular opinion that the disease is a rapid one is shown to be erroneous, it really being very slow. The bark of a limb may be affected through full four feet with the limbs still remaining green. Infection rarely shows in less than nine days, and then progresses no more than an inch per day.

The disease has been observed making progress during two winters ; in one instance it continued into the spring, in the other it suddenly stopped at the time the leaf buds expanded.

The size and appearance of the bacteria are described. The chief change observable in the tissues of the plant is the early removal of the stored starch; the walls of the cells do not appear to be affected. In young parts all the tissues except the epidermis seem equally affected, but in older limbs the chlorophyll-bearing cells of the bark are the first and chief seat of the disease. The cambium is tardily affected.

The chemical products of this disease, determined by Prof. H. A. Weber, are said to be carbon dioxide and butyric acid.

1881. PEFFER, GEO. P. (Pewaukee, Wis.), and others. Apple tree blossoms—blight [with discussion]. Trans. Wis. Hort. Soc. for 1881–2, vol. XII., p. 194. [8½ pages on blight.]

In making a special study of apple blossoms in the spring of 1881 the following facts regarding blight were observed : The first flowers appeared

June 4 and 5. The next few days were hot with dry southwest winds, the thermometer standing at 90° to 96°. The petals soon turned brown, followed by the blackening of the leaves just below the flowers, and the exudation of the "black liquid usually seen with fire blight." Apples and crab apples were affected alike, and on both the north and south sides of the trees. "All the trees that were in full bloom during those hot days were thus blighted, and in a few days looked as though a fire had run through them, while the same varieties standing only a few rods apart that had no blossom stems or were not yet in bloom, escaped altogether, not only then, but all through the season." The blight, starting in the flower, passes down the flower stem to the shoot, when all the flowers of the cluster become affected, if they have not been so before. "From this point it works down in the new wood," and "to the leaves surrounding the flower stems." It is easily checked at this stage in apples and crabs by removing the twig or by cool weather. In the pear it is liable "to run down in the older wood and to extend until the tree is killed," which occurs the "second year if not the first." Girdling below the diseased part seems to arrest the disease the same as amputation.

Believes it occurs because there is not a sufficient supply of sap to keep the flowers from withering in the hot wind, which is the reverse of the theory heretofore held by all western fruit growers, the author included, to the effect that blight is due to too great abundance of sap.

Specimens of these blighted blossoms and twigs were sent Prof. Burrill, who replied under date of Jan. 19, 1882, that "there is no question but that your idea that the blight starts in the blossoms in these cases is true. It is quite new to me, but I now find similar evidences of the fact here."

Burrill's theory of the bacterial cause of blight is not accepted, for the experiments failed to convey the disease without puncturing the shoot. This appears to show that the bacteria cannot gain access through the uninjured parts, and hence could not of themselves start the disease. Blight may be caused by frozen sap, "injuring the cellular structure, so that when warm weather sets in fermentation commences."

"Remedies are cutting away the limb, or removing the bark on large limbs below the diseased part. Apply lime and sulphur to the tree. If the weather gives indications of blight, mulch the trees, or apply salt to keep the temperature down.

In the discussion D. McDonald (Verona, Wis.) spoke of a tree standing close against the south wall of a stone house, that did not blight, as it probably would have done if the heat were the cause of the disease. Mr Peffer explained it by supposing that the air must circulate freely there, and that the tree makes a slow growth, both of which circumstances would counteract the heat. R. P. Speer (Cedar Falls, Iowa) had observed that rust, mildew and blight generally made their appearance under the same atmospheric conditions. The germs of fungi and bacteria get into the plant when the weather has brought about an undue pressure of sap, and it has been forced out at the ends of the shoots. It is doubtful if such germs are the direct cause of diseases. It could not be caused by cold weather, as it does not always affect tender trees the most, and is often severest when the weather has been the mildest. Preventive is to keep down the temperature of the soil and to secure slow growth.

1883. Burrill, T. J. (Champaign, Ill.) Pear blight and peach yellows. Trans. Ill. Hort. Soc. for 1883, p. 46. [3 pages on blight.]

An argument is framed to show that the bacteria accompanying blight are the cause of it, from the fact of their invariable presence, communicability by inoculation, and the analogy with animal diseases. Details in reclaiming diseased trees by excision are given. Confirms Mr. Peffers observation of the access of blight through the flowers.

1883. Burrill, T. J. (Champaign, Ill.) New species of Micrococcus (bacteria). Am. Nat., vol. VII, 1883, p. 319. [½ page on blight.]

Same in Grove's Bacteria and yeast fungi, London, 1884, p. 10.

Abstract in Jour. Royal Micr. Soc., vol. III, 1883, p. 399.

The technical description of M. amylovorus Bur., with notes on its occurrence and action. "It may be cultivated in pure starch in water."

1884. Burrill, T. J. (Champaign, Ill.) Trunks of apple trees. Trans. Miss. Valley Hort. Soc. for 1884, vol. II, p. 178. [1 page on blight.]

Same in Trans. Wis. Hort. Soc. for 1884–5, vol. XV, p. 216, [1⅓ page.]

The so-called "sun-scald," which occurs on any part of the trunk, but more commonly on the south side, and in which the bark adheres firmly to the wood, is found by examination and inoculation experiments to be due to blight bacteria. The cambium is not always affected, and it may form a new bark and heal the spot. The heat of the sun promotes the growth of the bacteria; hence the more frequent occurrence of the disease on the south side, and on trees leaning to the northeast. Bacteria probably gain access through cracks in the bark. Leaning the trees toward the southwest, and providing a shield to the trunks, are protective measures.

1884. Penhallow, D. P. (Montreal, Can.), and others. [Discussion on pear blight.] Rep. Mass. Agric. for 1884, p. 65. [4 pages.]

Does not "pretend to cure it yet," but has "submitted trees to treatment involving the use of sulphate of potash as a special fertilizer, and phosphates as a general food for building up the constitution, with a considerable degree of success." Considers the disease constitutional, and that lack of nutrition is one of the primary causes. In hundreds of examinations has found but one pear tree in normal health, and thinks that in the reported cases of inoculation of the disease with pathogenic bacteria, "the subjects were not in proper condition for inoculation."

B. P. Ware (Marblehead, Mass.) thinks the disease not constitutional, as it appears on different limbs of the same tree in different years, but "the whole tree is not affected at the same time." Mr. Hadwen had known the pear blight some fifty years, and always ascribed it to high cultivation.

1884. Arthur, J. C. (Geneva, N. Y.) Report of the botanist. Rep. N. Y. Agric. Exper. Station for 1884, p. 357. [11½ pages on blight.]

Review in Country Gentleman, vol. L, 1885, p. 662. [¾ col.]

Review in Gard. Monthly, vol. XXVII, 1885, p. 284. [1⅓ col.]

Resumé by Dr. J. H. Wakker in Nederlandsche Tuinbouwblad (Holland), vol. II, 1886, p. 9.

Partial account in Botanisches Centralblatt, vol. XXIV, 1885, p. 335. [½ page on blight.]

1885. ARTHUR, J. C. (Geneva, N. Y.) Proof that bacteria are the direct cause of the disease in trees known as pear blight. Proc. Amer. Assoc. Adv. Sci., vol. XXXIV, 1885, p. 295. [2¾ pages.]

Same in Bot. Gaz., vol. X, 1885, p. 343. [2½ pages.]

Same in Gard. Chron., vol. XXIV, 1885, p. 586. [1½ col.]

Abstract, with comments, by L. Forquignon, in Bul. Soc. Myc. de France, No. 3, 1886, p. 193. [2 pages.]

The germs were cultivated in sterilized infusion of corn (maize) meal for nearly four months, during which there were six transfers, and then inoculated into green fruit of Bartlett pear, and the disease produced in full force. The juices of blighting tissues, from which the bacteria had been removed by filtering through porcelain, failed to start the disease when introduced into green fruit. Both experiments were duplicated. The conclusion is that the bacteria are "the direct cause of the disease."

1885. ARTHUR, J. C. (Geneva, N. Y.) Report of the botanist. Rep. N. Y. Agric Exper. Station for 1885, p. 241. [7½ pages on blight.]

Brief abstract in Bul. Soc. Myc. de France, No. 3, 1886, p. 196. [⅓ page.]

1885. ARTHUR, J. C. (Geneva, N. Y), and others. Pear blight [with discussion]. Proc. Am. Pom. Soc. for 1885, p. 44. [7¼ col.]

Same in Rep. Mich. Hort. Soc. for 1885, p. 173. [4½ pages.]

Same in Mich. Hort., vol. I, 1886, pp. 222, 287. [5½ col.]

Nearly complete in Rep. Ohio Hort. Soc. for 1885–6, p. 154. [2 pages.]

Partial report in Orchard and Garden for Dec., 1885, p. 36. [2 col.]

Resumé, in part, by E. F. Smith in Mich. Hort., vol. I, 1885, p. 34. [2½ col.]

The same ground is covered as in the American Naturalist. E. Moody (Lockport, N. Y.) said that he, having "whitewashed with lime and sulphur, has had no blight for five years." Several persons asked questions that were answered by Mr. Arthur.

1885. ARTHUR, J. C. (Geneva, N. Y.) Pear blight and its cause. Amer. Nat., vol. XIX, 1885, p. 1177. [8⅓ pages.]

The disease and its effects are described, as also the appearance, size and motions of the bacteria, and the chemical changes they induce. The course of the investigation by means of inoculations and cultures is gone over, and finally the proof is given that the bacteria associated with the diseas cause it.

1885. [MEEHAN, THOS.] Fire blight in the pear. Gard. Monthly, vol. XXVII, 1885, p. 297. [½ col.]

"A dozen different diseases are all confounded as pear blight." "The idea that fire blight is contagious or even infectious, is surely thoroughly exploded;" and the advice to promptly cut away diseased branches "seems very strange at this late date." These statements are prompted by reading a recent article; "professors of horticulture in schools and colleges" are admonished to familiarize themselves with "horticultural publications of the past twenty-five years," so as not to be "a long way behind the age."

1886. [MEEHAN, T.] Fire blight in the pear. Gard. Monthly, vol. XXVIII, 1886, p. 25. [1 col.]

Commends an article by J. C. Arthur in "Amer. Naturalist" as "worthy of perusal by those interested in intelligent pomology." It confirms the opinion long held by the editor, that "fire blight must of necessity be of fungus origin." "It was evident that the cause . . . was local, and therefore induced by some special influence operating on particular parts of a tree, wholly independent of the plant itself." Prof. Burrill's announcement of bacteria as the cause "was fully in accord with our prepossessions."

1886. ARTHUR, J. C. History and biology of pear blight. Proc. Phila. Acad. Nat. Sci., 1886, p. 322. [20 pages.]
Review in Count. Gent., vol. LI, 1886, p. 954. [¾ col.]

The distribution of the disease is discussed, showing that it is doubtless confined to that part of North America east of the Rocky Mountains. Some notion of the amount of loss it occasions, and its prevalence in the early part of the century are given. The several prominent theories regarding its cause, such as sunstroke, insect, frozen-sap, fungus, electricity and bacteria, introduce the subject of the beginning of experimental research. A successful inoculation was made as early as 1845 by Mr. Ragan, of Indiana, and an excellent explanation of the cause of the disease by Mr. Gookins given in the same year. Bacteria in connection with the disease were discovered by Prof. Burrill, and a rigid proof that they are the cause of it, established by the author. The appearance of the organisms, their development in artificial media, behavior toward staining fluids, chemical products formed during growth, and their action in the living plant are described. The paper is accompanied by a plate illustrating the active and zooglœa states.

Report of the Chemist.*

The experimental work in the chemical laboratory for 1886 has been principally a continuation of the study of milk and butter begun last year, and described in the last report. In connection with this work, much time has been given to the construction of a new viscometer, which promises to be of great assistance, as it furnishes a means for the investigation of certain important properties of milk and butter that have hitherto escaped recognition.

The analysis and artificial digestion of fodders have received more attention than during any previous year. This work has been conducted by Mr. Ladd, the assistant chemist, and a full account of the results will be found in his report.

Monthly examinations of the drainage water from the three lysimeters, and a daily record of the amount of sunshine received have been made in the same manner as in previous years, and are herein tabulated.

VISCOMETRY.

A few experiments made with artificial emulsions, about one year ago, seemed to show that the creaming and churning qualities of milk were largely dependent upon its viscosity, and several attempts were made to measure this property of milk. The apparatus used for these trials consisted of a pipette with small jet, and was similar in principle to the viscometers generally employed for testing oils. It was soon demonstrated that methods of this kind could not be applied to milk, as small particles of solid matter are invariably present which partially clog the opening of the pipette so that duplicate determinations with the same sample rarely give concordant results. Experiments were also made with mechanical devices, none of which were successful, till the apparatus described below was constructed.[1]

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[1] The description of this apparatus is taken from a paper, entitled A New Viscometer, read before the Chemical Section of The American Association for the Advancement of Science at the Buffalo meeting, 1886.

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*S. M. Babcock.

The apparatus consists of a disc of metal supported in its axis by an elastic wire, the torsion of which causes the disc to oscillate when a motion of rotation is imparted to it. At the lower end of this axis is rigidly attached a hollow cylinder, open at both ends, which is immersed in the liquid to be tested. The damping effect which the liquids examined have upon the motion of the disc furnishes a most sensitive measure of their viscosities. The motion being quite slow, and its direction being frequently reversed, there is little tendency to the formation of currents, and external friction is reduced to that of the air and the viscosity of the wire. Moreover, small particles of solid matter have little influence, as there are no corners and no projecting points against which they impinge.

The arcs of oscillation of a body suspended in this way diminish in a geometrical series, the ratio of which depends upon the relation between the moment of inertia of the suspended body, the coefficient of torsion of the wire and the resistance to which it is subjected.

For the purpose of determining the length of the arc of oscillation, a circular protractor is attached to the upper surface of the disc, and a pointer fixed to the frame of the apparatus, directly above but not in contact with the scale.

The scale is numbered on the inside of the graduation from 0 to 360°, and on the outside the numbering is continued to 720° so that any arc may be directly read up to two complete revolutions. The point of equilibrium is adjusted by turning the support to which the upper end of the wire is attached until the zero point is directly beneath the stationary index. The reading may be greatly facilitated by a suitable magnifying glass placed directly above the index.

The essential parts of the apparatus should be so proportioned that the time of oscillation between two successive turning points will not be less than twenty seconds, and when very close results are essential the time of oscillation should be a minute or more, in order that the readings may be taken with accuracy.

The general construction of the apparatus is shown in figure 1, in which A represents the suspended disc; B, the scale consisting of a card board protractor 8 inches in diameter, and divided to half degrees ; C, the stationary index; D, a large bulls eye lens; E, the resistance cylinder; F., vessel containing the liquid tested; C, the suspending wire; H, attachment of the wire; I and K, frame which incloses and supports the apparatus.

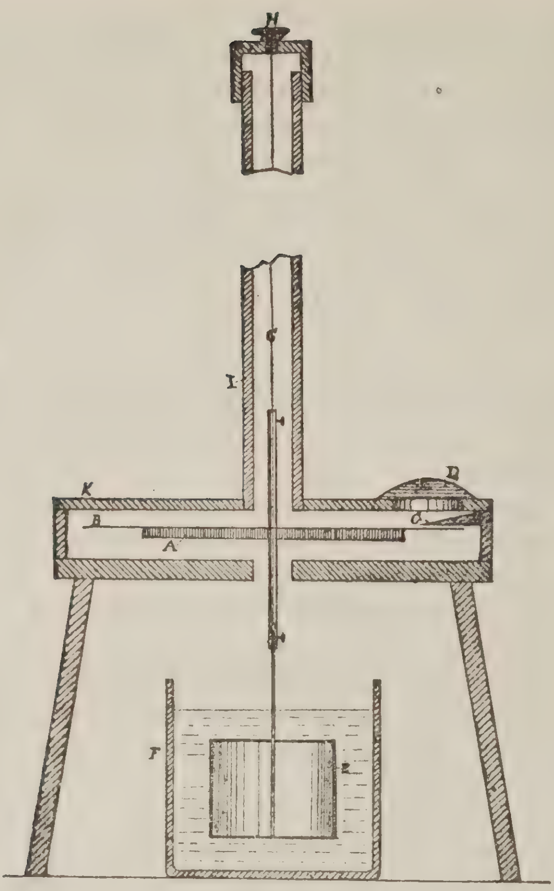

Fig. 1.

The several parts have the following dimensions. The wire is of tempered steel 0.2 millimeter in diameter and 110 centimeters long. The disc is of lead 12.6 centimeters in diameter and about 0.5 cm. thick, mounted in the middle of a brass axis 15. cm. long, and weighs, with its axis and resistance cylinder 1150 gms. The moment of inertia of the disc with the resistance cylinder attached is about 2,000,000,000 mgr. mm^2 and its time of oscillation 35 seconds.

The resistance cylinder is made from a piece of brass tubing 6.4 cm. in diameter and 5 cm. long, and is supported by a stiff wire which is connected to the axis of the disc by a small set screw so that it may be readily removed for cleaning.

The liquid to be tested is placed in a beaker, or other suitable vessel, which should be large enough to allow at least two centimeters between its sides and the revolving cylinder. The same vessel with which the apparatus is calibrated should be used in all cases. The revolving disc should be inclosed to protect it from currents of air, which have a decided influence upon the result.

In order to determine the retardation due to the resistance of any substance, an impulse is given to the disc, with the cylinder immersed in the liquid, and the reading of the scale at each successive turning point noted. Any length of arc may be taken, but the initial impulse should be the same in all cases and should correspond to that for which the instrument is calibrated. An arc of large amplitude has an advantage, as it reduces the influence which errors of scale reading have upon the result. In the tests already made, the initial impulse has been given by turning the disc, in the direction which causes the numbers on the scale to diminish, through one complete revolution or 360° the starting point is then 0 and the first reading gives the length of arc of the first oscillation. In order to start the disc exactly at the zero point without vibration, it is necessary to have a clamp by which it may be held in the proper position and instantly released. The difference in the scale reading at adjacent turning points, gives the length of the arc of oscillation. The ratios of damping with different solutions may be best compared by the logarithmic decrements of these arcs. Representing the amplitude of the mth swing by a, and that of the nth swing by b, the logarithmic decrement will be

$$\frac{\log. a - \log. b}{n - m}$$

The number corresponding to this logarithm will be the ratio of damping. Five or six swings are sufficient for this determination.

It is possible, by determining the necessary constants of the apparatus, to calculate from the diminution of the arcs of oscillation the amount of energy required to overcome the resistance which any liquid offers, but the mathematical considerations involved are too complicated for general use, and would lead to confusion in the results, if this were taken directly as a measure of viscosity. To avoid the necessity for this calculation the viscosity imparted to distilled water by pure cane sugar is taken for a standard of comparison, the apparatus being calibrated as follows: A number of solutions, each containing a known quantity of sugar, are prepared and the amount of damping which each of these produces is determined. A curve is then constructed in which ordinates represent the number of grams of sugar per litre, and abscissas the amount of damping. This curve is quite regular, so that few points are required for its construction, and when once made furnishes a simple means for expressing the viscosity of any liquid within its range.

The amount of damping may be expressed in several ways, two or three of which are indicated below. The sum of *m* arcs of oscillation, or the length of the *m*th arc of oscillation, or the reading of the *m*th turning point may be taken for the abscissas, but these methods require that the starting point in all determinations be absolutely the same, and that the index be adjusted exactly at the zero point of the scale. These precautions are not necessary if the abscissas are made to correspond to the logarithmic decrements obtained with each solution, as these are not materially affected by slight changes in length of arc. Four place logarithms may be used and the logarithmic decrements found taken as whole numbers, for the construction of the curve. See fig. 2, which represents a curve of this kind on a much reduced scale.

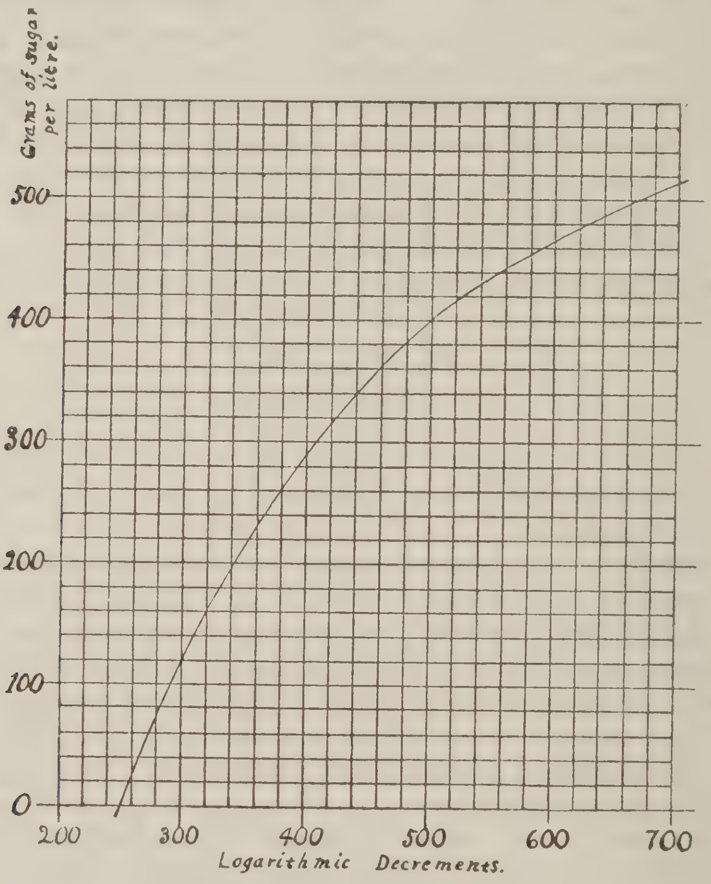

Fig. 2.

Having constructed a curve in one of these ways the viscosity of any liquid, more viscous than water, may be referred directly to a solution of sugar of the same viscosity, in which the amount of sugar is known, and this expressed in grams per litre gives the viscosity, on the scale adopted.

The utmost care is necessary in adjusting the temperature of the liquid tested, as very slight changes have a marked influence on the viscosity, increasing it rapidly as the temperature falls. Twenty degrees C., has been adopted as a standard temperature, this being near the average temperature of the room where observations are made. If the temperature of the room varies more than one or two degrees from that selected for a standard, some arrangement for maintaining the temperature constant during the test is necessary. A wooden vessel, containing a considerable quantity of water adjusted to the proper temperature, in which the beaker containing the liquid tested may be placed, answers for this purpose. If the substance under examination is one whose coefficient of change for temperature is known, any temperature may be taken, and a corresponding correction can be made.

It is evident that the sensitiveness of the apparatus may be increased or diminished to any desired degree, by changing the resistance cylinder for one larger or smaller, or by changing the wire for one having a different coefficient of torsion. It also has an advantage over other methods in being applicable for substances having a wider range of viscosity, and in giving results with different instruments which are strictly comparable.

In order to better illustrate the use of the apparatus, an example is given.

Scale reading. Degrees	No. of arc.	Arc of oscillation.	Logarithms of arc.
686.1 65.8	1	620.3	2.7296
625.8 120.0	3	505.8	2.7040
577.2 163.7	5	413.5	2.6165
538.0 199.0	7	339.0	2.5302

The arcs of oscillation given above are for the first, third, fifth and seventh arcs, the intermediate ones being omitted so as to avoid the use of the same scale reading twice. The logarithmic decrement derived from the first and seventh arc is

$$\frac{2.7926-2.5302}{6}=.0437.$$

and from the third aud fifth

$$\frac{2.7040-2.6165}{2}=.0437.$$

The logarithmic decrements found by the two calculations should not differ more than 1 or 2 in the last figure. A greater difference would show a considerable error in scale reading, and the test should be repeated. Considering this decrement as a whole number, we find by referring to the curve given in fig. 2, that it represents a viscosity equivalent to a solution of sugar containing 330 grams to the litre. The viscosity is therefore 330.

A few substances, among which are the lighter mineral oils, are less viscous than distilled water. For such, the above scale of viscosity furnishes no expression. If it were possible to continue the curve of viscosity indefinitely in this direction, the viscosity of all fluids could be stated in the same terms. I have not succeeded in doing this, and it seems necessary to adopt an artifical scale for liquids less viscous than water. I have considered such viscosities as negative and directly proportional to the difference between the logarithmic decrement found for the substance, and that for water at 30° C., this being the zero point of the scale. For convenience, I have assumed that distilled water at 20°C. represents 100 degrees of viscosity, so that the logarithmic decrement due to the resistance of water divided by 100 gives the decrement for one negative degree.

In order to make this plain, the following example is given. With the viscometer which I have used the logarithmic decrement with distilled water at 20° C. is .0233. Deducting from this the logarithmic decrement caused by the resistance of the air and wire which is .0043 gives the decrement due to water alone, viz., .0190 and this divided by 100 gives .00019, the decrement for each negative degree with the instrument used.

A sample of benzine gave a logarithmic decrement of .0147, its viscosity is therefore— $\frac{.0233-0147}{.00019} = -45$. While this scale does not in any way correspond with that for liquids more viscous than water, I believe it will give concordant values with different instruments, and thus enable observers to compare results. It will, however, be advisable, so soon as absolute values are determined, to change these negative values to correspond to the positive scale.

Aside from the examination of milk and butter, for which this instrument has been chiefly used, it will, I trust, find many applications in other lines. It appears to be especially well adapted to the examination of oils. Only a few tests, with the lighter oils have as yet been made, but with these it indicates very slight differences. The addition of one per cent. of benzine to a given sample of head light oil is readily shown, the difference in the logarithmic decrements for these oils being more than 100, with the apparatus used. This difference could be largely increased by using a larger resistance. For the heavy oils a much smaller resistance would be necessary, and possibly a heavier disc and stiffer wire would be an advantage.

Adulterations in sugar may be detected by dissolving a known weight in water, and making the solution up to a litre. The viscosity of the solution should equal the number of grams of sugar taken, if it is pure. The coefficient of viscosity for glucose is considerably less than for cane sugar, so that a small quantity added to sugar may be shown ,if 300 or 400 grams of the sugar are taken for the test.

THE VISCOSITY OF MILK.

The apparatus just described furnishes an expeditious and simple means for determining approximately the composition of milk, and is especially applicable when frequent examinations of milk from the same source are required. The viscosity of milk exceeds that of water on account of the solids which it contains, and no marked change either in amount or composition of the solids is likely to occur in milk from the same cow or herd without a corresponding change in its viscosity. Especially is this true if the specific gravity remains unchanged.

The testing of milk with this viscometer requires more care than when perfect solutions or simple liquids are examined. The fatty portion being much lighter than the serum, separates rapidly as cream, and unless a sample is thoroughly mixed immediately before a determination is made, the result will be erroneous. The most satisfactory way of obtaining a homogenous mixture is by gently pouring the milk from one vessel to another. Violent shaking should be avoided, as it introduces considerable air in small bubbles which escape slowly and affect the result. The temperature should be accurately taken and if possible adjusted to 20° C. The change in viscosity between 15° and 25° is for each degree abont 6, increasing as the the temperature falls; corrections on this basis may be made for a difference of one or two degrees.

Each of the solid constituents of milk has an influence upon its viscosity. The amount of viscosity caused by one per cent. of a solid in solution is termed its coefficient of viscosity; this is different for each of the constituents of milk. The ash appears to have very little effect and may in general be neglected. Its coefficient of viscosity has not been accurately determined.

Trueblood* has found that the transpiration time of 5 per cent solutions of cane and milk sugars are almost identical, so that their coefficients of viscosity may be safely taken as the same. This owing to the method of calibration is 10.

The fat offers considerable more resistance than sugar and its coefficient of viscosity is not the same in different samples of milk; its variation is quite marked in milk from different cows and is often considerable in that from the same cow at different times; it is less in mixed milk, and in milk from large herds would probably be nearly uniform; it seems to depend largely upon the size of the fat globules, large ones being associated with a large coefficient of viscosity.

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* Scientific American Supplement, No. 271.

I have as yet made no determinations of both the size of the fat globules and coefficient of viscosity in the same samples of milk, but a considerable number of examinations of globules in milk from the same cows used in these experiments have been made. Those values given below are taken from the fourth annual report of the N. Y. Agr. Exp. Station, page 274.

	Relative size of fat globules. 1885.	Coefficient of viscosity of fat. 1886.
Jem	344	17.6
Ann	220	13.3
Meg	156	9.1
Ceres	172	13.2
Juno	140	11.7

The size of the globules in the milk tested for viscosity was, no doubt, different from the values given, but no great change is probable. It is certain that the globules in Jem's milk have been uniformly large, while those in Meg's and Juno's have been quite small. The figures given, although not proportional to the viscosities are near enough to suggest a cause for the variable coefficient of the fat. The extreme values found for this coefficient are those given above.

The albuminoids of milk have a much greater influence upon its viscosity than any other constituent, and usually more than all of the other solids combined. Their coefficient of viscosity averages about 37. This, like that of the fat, varies in different milks, the variation being probably due either to the amount of albumen present or to difference in the solubility of the casein. The range is much less than with the fat being from 37 to 40 in the milks examined.

The coefficient of viscosity for the total solids as obtained from tests made at this Station has averaged about 19. This, however, is from milk containing about 5 per cent. of fat, and I think will be found too low.

The following table gives a few determinations made in milk of individual cows from the Station herd. The skimmilks were obtained from the corresponding samples of whole milk which were set about 12 hours in a Cooley creamer before being drawn off.

No.	WHOLE MILK.	Breed of cow.	Solids.	Fat.	Solids not fat.	Viscosity.	Coefficient of viscosity for total solids.
1	Nelly, July 15........	Jersey.	15.42	5.66	9.76	281	18.2
2	" " 19........	"	15.35	5.35	10.00	287	18.7
3	Jem, " 19........	"	14.56	5.19	9.37	276	19.
4	Ann, " 26.......	"	14.34	5.19	9.15	260	18.1
5	Meg, " 19.......	"	13.53	3.99	9.54	268	19.8
6	Juno, " 15... .. .	Native.	12.49	3.97	8.52	229	18.3
7	" " 26........	"	13.03	4.13	8.90	229	17.6
8	Ceres, " 15........	"	14.51	4.65	9.86	262	18.1
9	" " 26........	"	13.77	4.39	8.38	243	17.7
	Average...........	....	14.11	4.72	9.39	259	18.4
	SKIM MILK.						
1	Nelly July 15..........	....	11.07	.71	10.36	224	20.2
2	" " 19.........	....	11.38	.67	10.71	236	20.7
3	Jem " 19	....	11.15	.67	10.48	217	19.4
4	Ann " 26.........	....	10.14	.45	9.69	204	20.1
5	Meg " 19.........	....	9.97	.66	9.31	232	23.3
6	Juno " 15..... ...	....	*	.69	8.97	194	——
7	" " 26.........	....	9.80	.83	8.97	198	20.2
8	Ceres " 15...... ..	....	11.25	1.32	9.93	220	19.6
9	" " 26.........	....	11.34	1.03	10.31	216	19.
	Average...........	....	10.76	.79	9.97	218	20.3

The viscosities given in this table were determined with a defective apparatus, and are not strictly accurate. They do, however, show the relative values for the different milks.

By comparing the figures for the whole milks with those for the corresponding skimmilks the coefficients of viscosity for the fat and for the solids not fat are obtained for each sample of milk.

		Cofficients of viscosity.	
No.	Cow.	Fat.	Solids not fat.
1........	Nelly.................	14.0	20.7
2........	"	14.2	21.1
3........	Jem	17.9	19.8
4........	Ann.......	13.3	20.9
5.......	Meg	9.1	24.
6.... ...	Juno	13.5	20.5
7........	"	10.	20.8
8........	Ceres	13.2	20.3
9	"	13.3	19.7

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*Determination lost. The solids not fat are assumed to be the same as in sample 7.

It is to be regretted that churning tests were not made with these milks so that direct comparisons of the coefficients in these tables and the efficiency of the churn could be made. We have, however, considerable data in regard to the behavior, when churned, of the milk from some of these cows. There have been, during the past three years, a large number of churning tests with the milk of Jem, Ceres, Juno and Meg, which have shown that the value of their milk for butter is in the order named. The per cent. ratio of butter to fat in the milk for these cows has been Jem 100, Ceres 95, Juno 87.4, Meg 66. These numbers represent the relative efficiency of the churn for milk from these cows when tested, and it is not probable that sufficient changes would occur to materially affect the relative value of the milks.

For convenience of comparison, these values and the average coefficients of viscosity, together with the total viscosity of the fat and serum of these milks, is presented below:

	COEFFICIENTS OF VISCOSITY.		TOTAL VISCOSITY DUE TO		Per cent. relation of butter to fat.
	Fat.	Solids not fat.	Fat.	Solids not fat.	
Jem	17.9	19.8	93	183	100
Ceres	13.2	20.	74	178	95
Juno	11.7	20.6	44	185	87.4
Meg	9.1	24.	39	229	66.

These figures indicate that a high coefficient for the fat and a low one for the serum is most favorable to the economical production of butter. It is quite generally conceded that milk containing large fat globules is more readily churned and yields a greater proportion of its fat as butter than does that with small globules. If, as seems probable, the variation in the coefficient of viscosity of the fat is due to difference in the size of the globules, the relation between this coefficient and the efficiency of the churn is easily explained.

The influence of the viscosity of the milk serum in diminishing the efficiency of the churn has been confirmed by a number of experiments in which viscous substances were added to milk. In the example given below the same milk was used in each trial and all the samples were churned together in a test churn, the temperature being the same in each case. The mucilage added was a thin solution of gum arabic. The per cent. of butter is calculated for the quantity of milk used in each case.

No.	Milk c. c.	Water c. c.	Mucilage c. c.	Butter per cent.	Time churned. minutes.
1	400	....	....	4.37	20
2	350	50	....	4.54	20
3	300	100	....	4.45	20
4	350	....	50	2.86	40
5	300	....	100	0	80
6	300	....	100	2.6	80

The mucilage and the water were added to the samples when the milk was set. In numbers 5 and 6 containing 100 c. c. of mucilage, the casein separated in a short time and rose to the surface as cream leaving the serum below clear. In number 6 this was drawn off just before churning and replaced by an equal volume of water, thus greatly reducing its viscosity. Other tests of this kind were made with similar results. The addition of water, however, nearly always increased the time required for churning, owing, no doubt, to the proportion of fat being diminished.

Several attempts have also been made to churn colostrum milk, the serum of which is extremely viscous, and in no case was any butter obtained although the per cent of fat was above the average for milk. The analyses of two samples are given.

	I	II
Solids	27.00	27.39
Fat	3.90	3.98
Ash	.74	....
Albuminoids	18.75	19.31
Sugar	3.61	.....

If we assume that the coefficient of viscosity for the albuminoids in these samples was the same as in average milk the viscosity of the milk serum would have been 786 in No. 1, and a little more in No. 2.

When diluted with an equal volume of water and churned the result was the same as with the pure colostrum. In this last case the per cent of solids was about the same as in normal milk, but owing to the large proportion of albumen in solution, it was much more viscous. When three volumes of water were added a few granules of butter were formed after prolonged churning, but it could not be gathered. The addition of more than three volumes of water gave no better results. It could hardly be expected that butter would be obtained from these milks after being so largely diluted, as the per cent of fat was not much larger than is found in average buttermilk.

Another illustration of the influence of viscosity in retarding the action of the churn is furnished by the ordinary method of preparing whipped cream in which the formation of butter is prevented by the addition of a little gelatine to the cream.

In the determination of viscosity described above, the skim milk was obtained with a Cooley creamer and was necessarily several hours older than the whole milk when tested, so that possibly some changes had occurred which affected the coefficient of viscosity.

The following tests are presented to illustrate the method of applying this apparatus to the examination of milk. The samples tested were all from the same cow, and taken at intervals of two or three days, extending over a period of three weeks, every determination made being given. The samples of skimmilk were separated by a centrifugal, and obtained in each case from the whole milk of corresponding date.

The analytical results are presented in the following table.

WHOLE MILK.	Sp. Gr.	Total solid.	Fat.	Solids not fat	Casein.	Ash	Sugar by dif.	Viscosity.
December 1	1.0330	14.40	5.03	9.37	3.67	.73	4.97	274
“ 3	1.0337	15 61	5.88	9.73	4.24	.75	4 74	300
“ 6	1.0341	15.89	5.91	9.98	4.21	.63	5.14	301
“ 8	1.0326	15.26	5.74	9.52	3.99	.75	4.78	291
“ 10	1.0327	15.41	5.72	9.79	3.92	,69	5.08	288
“ 15	1.0327	14.98	5.49	9.49	4.02	.71	4.76	285
“ 17	1.0318	15.33	5.77	9.56	3.89	.73	4.94	293
“ 20	1.0332	14.97	5.32	9.65	4.05	.70	4 90	278
“ 21	1.0328	15.12	5.54	9.58	4.18	.75	4.65	287
Average	1.0330	15.22	5.60	9.62	4.02	.72	4.88	289
SKIM MILK.								
December 1	1.0386	10·69	.87	9.82	3.99	.79	5.04	216
“ 3	1.0403	10.76	.40	10.36	4.37	.78	5.21	214
“ 6	1.0399	10.81	1.32	9.49	4.37	.72	4.40	218
“ 8	1.0393	10.53	.35	10.18	4.21	.78	5.19	215
“ 21	1.0398	10.61	.36	10.25	4.27	.70	5.28	212
Average	1.0396	10.68	.66	10.02	4.24	.75	5.02	215

The coefficient of viscosity for the total solids derived frem the average figures in this table is, for the whole milk 19, and for the skimmilk 20.13.

If the average values for fat, solids not fat, and viscosity in the skimmilks be proportionally reduced so that the per cent. of solids not fat coincides with that in the average for the whole milk, we have for these corrected values: Fat 0.63, solids not fat 9.62, viscosity 206. Subtracting these from the corresponding values for whole milk, gives 4.97

per cent. of fat and 83. viscosity, or a coefficient of viscosity for the fat of 16.7. Substituting this last coefficient in the average analysis for the skimmilks, gives a coefficient of viscosity for the solids not fat of 20.36.

From these coefficients the following formulæ are derived:

x=per cent. of fat.
y= " " " solids not fat.
V=total viscosity of milk.
a=coefficient of viscosity for total solids.
b= " " " " fat.
c= " " " " solids not fat.

$$\text{Total solids} = \frac{V}{a}$$

then,

$$x + y = \frac{V}{a}$$

and,

$$bx + cy = V.$$

Solving these equations gives:

$$x = \frac{\left\{\frac{c}{a} - 1\right\}}{c - b} V, \text{ and } y = \frac{\left\{1 - \frac{b}{a}\right\}}{c - b} V$$

Substituting the values for *a*, *b* and *c*, found in the whole milk gives $x = .0195V$. $y = .0331V$.

The total solids, fat and solids not fat, in each of the whole milks mentioned in the last table, calculated by these formulæ are given below:

	TOTAL SOLIDS.			FAT.			SOLIDS NOT FAT.		
	Found.	Calculated.	Dif.	Found.	Calculated.	Dif.	Found.	Calculated.	Dif.
Dec. 1......	14.40	14.42	+.02	5.03	5.34	+.31	9.37	9.07	—.30
" 3......	15.61	15.79	+.18	5.88	5.85	—.03	9.73	9.93	+.20
" 6......	15.83	15.84	—.09	5.91	5.87	—.04	9.98	9.96	—.02
" 8......	15.26	15.32	+.06	5.74	5.67	—.07	9.52	9.63	+.11
" 10......	15.41	15.16	—.25	5.72	5.62	—.10	9.79	9.53	—.26
" 15......	14.98	15.00	+.02	5.49	5.56	+.07	9.49	9.43	—.06
" 17......	15.33	15.49	+.16	5.77	5.71	—.06	9.56	9.80	+.24
" 20......	14.97	14.64	—.33	5.32	5.42	+.10	9.65	9.20	—.45
" 21......	15.12	15.11	—.01	5.54	5.60	+.06	9.58	9.50	—.08

In these cases the variation in the composition of the samples tested is not large, although it is as much as usually occurs in the milk of a single cow for a like period and much more than would be expected in the mixed milk of a herd.

It is not to be supposed that the coefficients given above are applicable to milk from other sources, nor even to that from the same cow for an indefinite period; they must be confirmed or corrected by occasional analyses. I believe, however, that no material change will be found in these coefficients for milk from the same source so long as the relation between the specific gravity and the viscosity remains nearly uniform. Should the specific gravity increase or diminish considerably without a corresponding change in the viscosity, a change in the ratio of fat to solids not fat is indicated. This would of course change the coefficient of viscosity for the solids and necessitate an analysis.

I trust when more data are obtained that the relation between specific gravity and viscosity may be so established that corrections in the coefficients of viscosity may be made without the trouble of an analysis.

ANALYSES OF BUTTER.

In December of last year several samples of butter from the Chicago Live Stock Show for 1885 were furnished to the Station, by Major Alvord of Houghton Farm. This collection consisted of both genuine and adulterated butters exhibited at the show. They were designated by number only, the key being held by Major Alvord till the examination was completed.

The samples were first subjected to an examination for adulterations, by several different tests, the chief dependence being placed upon a partial determination of volatile fatty acids by Reichert's method. There were also determinations made of the insoluble fatty acids, and the melting points of both the butter fats and the insoluble fatty acids derived from them.

At the time these butters were received there was considerable controversy regarding the efficiency of Dr. Taylor's method for the detection of adulterations in butter by means of the microscope. An excellent opportunity was offered in these samples for testing this method in an impartial manner, and a microscopical examination of them was made before the nature of the butters was revealed by other tests. The butters were examined directly with polarized light and a selenite plate. and afterwards the crystals from the melted butters were examined in the same way for the "St. Andrews cross."

The direct examination with polarized light and a selenite plate showed prismatic colors in all of the adulterated butters, and a uniform tint in all of the genuine butters except No. 2, which appeared very much like the adulterated samples. The crystals from all of the butters, adulterated as well as genuine, gave a well defined St. Andrews cross with polarized light. This was also the case with neutral lard (No. 14) in which the cross was sharply defined though quite small. No. 15 consisted of stearine from the oleo-oil factories and showed no cross when examined by itself, but when combined with a small quantity of butter fat the crystals formed had the same appearance as those from pure butter.

The method has also been quite unsatisfactory in trials made at the Station with butters whose character was known. Whether these results were due to a lack of skill or to imperfect knowledge in the details of the work, I do not know. The uncertain results of some skilled microscopists, however, would indicate that the difficulty is inherent in the method. It certainly is not simple, and is not calculated to supersede the chemical methods now in use.

In the table presented below the column marked c. c. of $\frac{1}{10}$ NaOH indicates the amount of soda solution required to neutralize the fatty acids obtained from 2.5 gms. of butter fat by Reichert's method. The average for pure butter is about 14 c. c., and any sample requiring less than 12.5 c. c. may be considered adulterated.

The insoluble fatty acids were obtained by washing and weighing the portion left in the flask after distillation by Reichert's method. No attempt was made to recover the small quantity which is carried over with the distillate. These numbers are therefore somewhat lower than the average, but show in a satisfactory manner the adulterated samples, all of which gave over 90 per cent.

It was supposed that there would be found a much wider difference between the melting points of the fats and the insoluble acids derived from them, in the pure butters than in the adulterated ones. This was the case, although in numbers 12 and 13, both adulterated, the difference was nearly as great as in the pure butters. The melting points were taken, by the method described by Blythe, in a capillary tube open at both ends. The melted fat is drawn into one end of the tube and allowed to solidify. This end of the tube is immersed in a beaker of water the surface of which must be at a higher level than the top of the fat, and the water warmed. The melting point is taken when the fat rises in the tube. The results are not very satisfactory, although quite close duplicates may be obtained.

No.	c.c. of $\frac{1}{10}$ NaOH	Insoluble acids.	Melting Points. Degrees C. Butter fats.	Insol. acids.	Diff.
1	15.9	85.80	34.	41.	7.
2	15.1	....	35.	40.	5.
3	14.3	86.22	32.5	39.	6.5
4	14.6	84.47	31.5	40.	8.5
5	15.2	86.04	32.	40.5	8.5
6	13.9	87.02	30.	39.	9.
7	14.	84.95	29.	38.	9.
8	13.4	87.81	33.	40.	7.
9	5.4	92.36	38.5	41.	2.5
10	13.5	87.63	34.	41.	7.
11	14.	87.86	33.	40.	7.
12	2.5	94.04	35.	40.5	5.5
13	4.4	92.93	38.	42.5	4.5
14	5.8	95.00	42.5	43.	.5
15	3.8	94.51	53.	53.	
16	7.	90.37	....	41.	
17	1.6	94.55	....	40.5	
18	13.6	86 92	....	40.5	
19	14.	86.52	....	41.5	
20	13.7	85.93	....	45.	
21	13.3	85.07	....	39.7	
22	1.8	93.69	38.	40.5	2.5

ANALYSES OF THE ABOVE BUTTERS.

No.	Water.	Fat.	Ash.	Curd by Difference.	Comp. Color.
1	6.09	91.97	2.09	....	46.
2	6.55	89.22	3.15	1.08	92.
3	8.07	89.81	1.96	.16	72.
4	8.05	90.55	1.48	....	116.
5	7.70	89.98	3.01	....	116.
6	6.43	88.80	2.38	2.39	60.
7	14.69	81.25	2.35	1.71	80.
8	9.25	86.34	3 80	.61	100.
9	12.29	84.40	2.64	.67	40.
10	7.55	89.90	1.69	.86	84.
11	7.97	89.37	2.31	.35	76
12	7.30	89.84	2.73	.13	48.
13	10.87	86.67	2.38	...	52.
14	5.98	90.73	2.26	1.03	
15	.21	99.76	...	....	
16	12.66	83.31	3.36	.67	56.
17	8.34	84.63	6.02	1.01	36.
18	9.15	87.24	2.70	.91	80.
19	8.72	87.66	3.02	.60	60.

DESCRIPTION.

1. Pure Holstein butter made from Smiths & Powell herd. First De Laval premium and second for print butter.

2. Sweepstakes prize butter made by A. P. Foster, Plain View, Ia. Won six first premiums at Chicago show, 1885. Pure Jersey.
3. First premium for "creamery butter" made at any time. Made by McGray & Kessler, Kendallville, Ind.
4. First premium for butter from a single cow without regard to breed. A Jersey cow owned by Seth Wadham, Chicago, Ill.
5. First premium for pure Jersey butter. Made by D. M. Adams, Argenta, Ill.
6. First premium for shorthorn butter. Made by W. H. Fulkerson, Jerseyville, Ill.
7, First premium for pure Hereford butter. Made by Swan & Bosler, Indianola, Ind.
8. First premium for pure Holstein butter. Made by Thos. B. Wales, Iowa City, Iowa.
9. Armour & Co.'s best "creamery butterine" being 50 per cent. butter and 50 per cent. lard.
10. Special sweepstakes premium and medal offered by the National Butter, Cheese and Egg Association. Made by E. A. Berry, Adeline, Ill.
11. First premium butter made in the state of Pennsylvania. Maker unknown.
12. Armour & Co's. extra quality oleomargarine.
13. Armour & Co's. "Dairy butterine, 25 per cent. butter.
14. Armour & Co's neutral lard.
15. Stearine.
16. Oleomargarine made at one of the principal factories of New York. Obtained from N. Waterbury.
17. Armour's best butterine, being half Elgin butter and half neutral lard.
18. Elgin Creamery butter obtained from the general Chicago market.
19. Houghton Farm butter, pure Jersey. Made in January, 1886.
20. Butter from Jersey cow "Meg". Made at this Station.
21. Grocery butter. Geneva.
22. Lard.

The analytical results given in the above table were, with the exception of the determination of curd, obtained by methods described later in this report. Curd was taken by difference, and of course is subject to all of the errors of the analysis. The figures are mostly based upon single determinations, the quantity of butter received being in many cases too small for duplicate analyses. Otherwise some of the obvious errors would have been corrected.

METHODS OF ANALYSIS.

SAMPLING.

It has been found extremely difficult to take samples of butter from the same package and obtain concordant results by analysis. This is principally due to the fact that the water is not uniformly distributed throughout the mass, and mixing or working tends rather to separate the water than to distribute it.

As this water is usually a saturated solution of salt, the sampling effects directly the water and the ash, and indirectly all of the other constituents.

After trying various methods of sampling without success, the following was adopted and found to be very satisfactory, in so far that duplicate analyses of the same sample gave results which agreed closely.

A quantity of butter, large enough to represent the contents of the package from which it is taken, is placed in a wide mouthed, glass stoppered bottle or fruit jar, and melted by immersing the bottle in warm water. When the whole sample is melted the bottle is shaken vigorously and the shaking continued till the butter is again in a solid condition. The cooling may be hastened by immersing the bottle frequently in cold water. In this way a homogeneous mixture of all the constituents is obtained and the water is so finely divided that separation will not take place, so long as the butter is kept cool.

WATER.

The estimation of water is effected with the same apparatus and in the same manner as the solids of milk. (See Second Annual Report of this Station, page 168). The apparatus consists of a perforated test-tube about 5 inches long in the bottom of which is placed a tuft of clean cotton, and upon this sufficient ignited asbestos to fill the tube three-fourths full. The asbestos should be slightly pressed together to avoid large spaces. and a plug of cotton placed in the mouth of the tube to prevent the escape of loose fibers.

After weighing the tube the plug of cotton is removed, about 3 grams of butter put in and the cotton replaced. The tube is then placed in a drying oven, in an upright position, till the butter is melted and absorbed by the asbestos. A current of dry air is afterwards forced through the tube, which is kept at 100° C. till the weight is constant.

FAT.

The tube containing the dry butter from the water determination is transferred to an extraction apparatus and exhausted with ether. The ether is finally evaporated from the fat solution, and the fat, dried at 100° C., is weighed directly.

ASH.

A quantity of asbestos, more than sufficient to absorb the butter taken when melted, is ignited and weighed in a small platinum evaporator. Four or five grams of butter are placed in the evaporator, which is put in the drying oven till the butter is melted, and, if it contains a large quantity of water, till a portion of it is driven off; it need not be completely dried. A flame applied to the upper portion of the asbestos will ignite the fat, which will burn with a flame, without the application of external heat, till the fat is nearly consumed. In this operation the asbestos serves as a wick to supply the fat, and it will burn quietly with no spurting, unless the butter contains a large amount of water.

After the flame is extinguished, a low heat is applied to the bottom of the evaporator and the gases again ignited upon the surface. The heat may be gradually increased and the ignition should be completed at low redness. The ignition is greatly facilitated by a platinum reflector placed directly over the evaporator.

The same portion of asbestos may be used without error for several determinations unless the amount of ash should be very large.

CASEIN.

This has usually been determined by difference, but in some cases a determination of nitrogen has been made and the casein calculated. For this purpose about 10 grams of butter are digested with gasoline or benzine in a 150 cc. flask. In a short time the fats will all be dissolved, leaving the other constituents of the butter in the bottom of the flask. The fat solution is decanted and a second portion of gasoline added, which will remove nearly all of the fat from the residue. When the gasoline is evaporated, the nitrogen is determined by Kjeldahl's method. The amount of nitrogen multiplied by 6.33 gives the amount of casein. Results have been satisfactory.

COLOR.

The relative amount of color in butters may be determined with accuracy as follows: One gram of the fresh butter is digested with 15 c. c. of refined kerosene till the fats are completely dissolved, and the solutions filtered. The filtrate will be colored in proportion to the coloring matter of the butter, and may be compared to that from another butter, or preferably to a standard solution, by means of a Duboscq colorimeter. A standard color for comparison may be prepared by adding a small quantity of any of the commercial butter colors to kerosene oil. This standard will keep for a long time without changing, if kept from the light.

The scale of the colorimeter on the side which the butter solution occupies is always set at the same degree, while the scale for the other standard is made variable. The reading of this side will therefore vary with the amount of color in the sample.

If some of the kerosene oil in which the butters are dissolved be substituted for the solution of butter, a small reading will be obtained which should be deducted from that for each of the butters. The numbers remaining are directly proportional to the colors of the butters. In the butters thus far examined a fair colored Jersey butter was taken for a standard and called 100. The others were calculated to this standard from the scale reading.

THE DETECTION OF ADULTERATIONS.

At the present time only those adulterated butters which consist wholly or in part of fats derived from other sources than milk need to be considered. Adulterations of any other nature are rarely met with in this country, and should they occur, would be readily detected by simple tests.

The fats most extensively used for this purpose are neutral lard and oleomargarine oil. From these, by patented processes, are manufactured nearly all of the butterine and oleomargarine butters. In addition to the above, cottonseed oil and some other vegetable oils of a similar nature are used to a limited extent, but nearly always in connection with one of the above fats, which they serve to soften and bring more nearly to the consistency of butter. The detection of adulterations is therefore practically reduced to tests for lard and oleomargarine oil.

Blythe gives the composition of butter fat as follows :

	Glycerides	Equal to Fatty Acids.		
Olein	42.21 =	Oleic Acid.	40.40	
Stearin and Palmitin	50.00 =	Stearic and Palmitic Acids,	47.50	
			87.90	Total insoluble acids.
Butyrin	7.69 =	Butyric Acid,	6.72	
Caproin, Caprylin, and Rutin	.10 =	Caproic, Caprylic and Rutic Acids.	tr.	
	100.00 =		94.62	Total acids, calculating soluble as butyric.

The fats used for butter adulteration are composed principally of olein, stearine, and palmatine, so that the chief difference between them and butter is due to the small amount of butyrin which the latter contains.

The properties of butyric acid are essentially different from those of the other acids of butter or its substitutes, in that it is volatile, soluble in water, and has, comparatively, a low molecular weight.

Upon these characteristic properties of butyric acid are based nearly all of the tests for adulteration which are considered reliable, and as it occurs in all genuine butters, its absence is conclusive evidence that the sample examined is spurious. The quantity found is, within certain limits, a measure of the amount of adulteration.

Reichert's method, which is the one at present most generally adopted, depends upon the amount of volatile fatty acids obtained, under certain prescribed conditions, from 2.5 gms. of fat. There is required for neutralizing the fatty acids obtained by this process from genuine butter about 14 c.c. of $\frac{1}{10}$ normal soda solution. The range is from 12.5 c.c. to over 16 c.c. for pure butters. The fats used for butter adulteration require from 0.5 to 5. c.c.

Hehner and Angell proposed the estimation of insoluble fatty acids as a measure of adulteration. The average amount of insoluble acids as found by the authors in genuine butter was 87.24 per cent, and varied in the samples examined from 86.1 to 88.2 per cent. Twenty-one samples examined in the laboratory of the New York Dairy Commissioner gave an average of 88.33 per cent, with a range from 86.40 to 90.24 per cent.

Thirty-one samples examined by Dr. Wiley, at Washington, averaged 88.17 per cent. with a range from 86.43 to 89.89. These determinations give an average for American butters of about 88.2 per cent. with a range from 86.4 to 90.2 per cent.

The amount of insoluble acids in lard and beef fat is over 95 per cent. and about the same for cotton-seed oil.

The soluble acids in butter amount to about 5 per cent. with a range of one per cent. either way. Lard and oleomargarine oil contain none at all.

On account of the low molecular weight of butyric acid more alkali is required to saponify butter fats than any of the fats with which it is adulterated. Koettstoerfer has shown that one gram of butter fat requires 221 to 233 miligrams of potassium hydrate, and one gram of other animal fats 195 to 197 miligrams. The range for American butters is about the same. The average derived from analyses of Wiley and Martin is 225 miligrams.

For convenience of comparison the range for each of the above methods is presented in tabular form. The last column shows the amount of adulteration, lard, oleo oil, etc., which may be added to an *average* sample of butter without passing the limit for pure butters. It is evident that this last amount might be doubled with a butter giving the extreme value.

Method.	Range for genuine butters.			Adnlteration possible without detection. Per cent.
	Min.	Max.	Average.	
Reichert's c. c. $\frac{1}{10}$ Na O H..	12.5	16+	14	10+
Insoluble acids, per cent.....	86.4	90.2	88.2	20+
Soluble acids, per cent......	4.	6.	5.	20
Koettstoerfer...	221.	223.	225.	12+

From the above scheme it is plain that Reichert's process is capable of detecting a smaller proportion of adulteration than any of the others.

Koettstoerfer's method is simple in its details and would appear from this table to be capable of showing nearly as small a percentage of adulteration as Reichert's, but the sources of error in it are large so that, in reality, more dependence may be placed upon determinations of the soluble and insoluble acids than upon this.

These considerations have led to the quite general adoption of Reichert's method by chemists whenever the quality of butter is to be determined.

THE VISCOSITY OF BUTTER SOAPS.

In making examinations of butter by Reichert's method I have often observed a very marked difference in the solubility of the soaps formed from genuine and from adulterated butters or other animal fats. While the potash soap from butter fats, made according to Reichert's directions, is readily soluble in 50 c.c. of water, that made from lard or oleo-oil, or from samples containing a large proportion of these oils can only be dissolved by warming, and the solutions when formed appear much more viscous than solutions of the butter soaps. This characteristic property is so marked that nearly all of the butterine and oleomargarine butters may be detected by a simple inspection of these soap solutions without further tests. This fact suggested that perhaps the measurement of the viscosity of solutions of soaps made from the different fats and oils, might furnish a ready means for identifying them.

To test this, a preliminary trial was made with neutral lard and butter fat. Twenty grams of each of these were saponified with about 10 grams of caustic potash by heating with a quantity of alcohol. No especial care was taken to have exact quantities either of potash or alcohol. The soaps formed were dissolved in water and the solutions made up to 500 c.c. The vicosity of these solutions, tested with the viscometer described in another portion of this report, was for the butter fat 65, and for the neutral lard over 500.

This marked difference was a surprise and naturally led to a series of careful tests to determine whether in mixture of the two fats the viscosity would be proportional to the quantities taken. First the above experiment was repeated with butter fat, neutral lard and oleo-oil, 20 grams of each being taken, and, to avoid a large excess of alkali, only 6 grams of caustic potash were added to each. They were saponified by heating upon a water bath with 20 c.c. of alcohol, the heating being continued till the alcohol was driven off. The soaps were dissolved in water and made up to 500 c.c: The viscocity of these solutions at 20°C. was for the butter fat 62, neutral lard 70, oleo-oil 68 or practically the same for each. On the supposition that the difference in the first case was due to an excess of alkali, the tests were repeated with seven, eight and nine grams of caustic potash the other details of the experiment being the same as before, without any marked difference being found in the viscosity of the solutions from the different fats. With 10 grams of caustic potash the soaps from the neutral lard and oleo-oil were quite viscous, while that from butter fat was only slightly changed. The addition of more alkali was found to increase the viscosity of the soaps from neutral lard and oleo-oil quite rapidly, while that of the butter remained nearly the same till about 15 grams of caustic potash were used for 20 grams of fat, and was not extremely viscous when 20 grams of potash were used.

The results given below are the average of several determinations, but are only approximate as they were obtained with an instrument not properly adjusted. They do, however, show the relative viscosity for the different fats.

Amount of caustic potash used, grams	7	8	9	10	13	15	16	18	20
Butter soap, viscosity	60	66		67	78	85	114	162	252
Oleo-oil " "	72	102	108	474	too viscous to test.				
Nentral lard soap, viscosity	88	89	130	480	"	"	"	"	
Sesame oil " "		...	...	276					

These results were entirely satisfactory and indicated that the difference in the viscosity of solutions of soap made from butter fat and from those fats generally used for butter adulteration could be increased to any desired extent by the addition of alkali.

These tests were followed by a large number of examina- of adulterated butters, and of the fats and oils which are used for this purpose. The samples examined were obtained both from the general markets and from the leading factories throughout the country. In every instance the soaps from the adulterated samples greatly exceeded in viscosity those from butter fats, when from 10 to 15 grams of caustic potash were used for saponification.

Tests were next made to determine how small a proportion of adulteration could be detected with certainty in this way, with the following results:

	Caustic potash used: grams.	10	13	16
Viscosity of	Butter	67	78	114
	50 per cent butter 50 per cent neutral lard		416	...
	75 " " " 25 " " " "		228	...
	90 " " " 10 " " " "	68	212	..
	95 " " " 5 " " " "		94	276
	95 " " " 5 " " " "	72	144	...
	75 " " " 25 " " sesame oil		227	450
	80 " " " 20 " " " "		197	385
	95 " " " 5 " " " "		114	258
	95 " " " 5 " " " "	76	227	...

The apparent discrepancies in this table may be accounted for by the fact that the butter fat used in these tests was not all taken from the same sample. These figures like those in the table preceding were mostly obtained with a defective apparatus and must be considered only in a relative sense. No tests were made with less than five per cent. of adulteration, but there is little doubt that by making the solution more alkaline the addition of one per cent. of adulteration to any given sample of butter would be readily shown.

The butters used in these experiments were mostly made at the Station, from milk of the Station herd consisting of both native and Jersey cows. In some cases the butter from individual cows was used. Two or three samples were obtained from groceries in Geneva and one sample of Jersey butter was nearly a year and a half old. There were in all nearly 20 samples of butter tested. When only 10 grams of caustic potash were used there was practically no difference in the viscosity of the soaps obtained and with 15 grams of potash the variation was small, not enough to prevent the detection of 5 per cent. of adulteration.

In October, some time after the above tests were completed, a large number of butters were obtained from different sections of the country, which included samples made from milk of different breeds of cattle and from milk treated in different ways. Several of these butters were taken from the exhibit of the Bay State Fair, held in Boston early in October. These were tested with a new viscometer in which the faults of the first instrument were, as far as possible, corrected.

The variation in the last lot of butters was so great as to materially modify the conclusion reached above. The figures obtained, together with those from many other fats and oils, will be found in the next table. In order to avoid the trouble of weighing the caustic potash for each test a very concentrated solution containing 2 grams of fused potassium hydrate in each 3 cubic centimeters was prepared, and the amount required measured with a pipette in each case. 1 c. c. of this solution was equivalent to 0.55 gms, KOH.

The fats were soponified as follows: Twenty grams of the filtered fat were weighed in a beaker of about 500 c.c. capacity and 15 c.c. of the potash solution, equivalent to 10 grams of caustic potash, were added. Ten cubic centimeters of alcohol were also added, to facilitate saponification. Without alcohol, saponification is incomplete, after being heated a long time. The fat and alkali are heated upon a water bath with frequent stirring till the alcohol is completely driven off. About 350 c.c. of water is then added to the contents of the beaker, which is kept upon the water bath till the soap is all dissolved. The solution is made up to 500 c.c. and when cooled to 20°C. the liquid is adjusted to the mark and the viscosity determined. In case the fat examined is an animal fat, as oleo oil or neutral lard, the solution formed will be quite viscous when cooled and will be turbid, owing to the separation of insoluble soaps. The solution of soaps from butter fat are clear amber colored when warm, becoming slightly turbid at 20°C., but not so much so as other animal fats.

After determining the viscosity of the soap solutions, 5 c.c. of the potash solution are added, the solution warmed to dissolve the precipitate which forms, and after cooling to 20°C. the viscosity is again determined. The viscosity found in this second trial will be a trifle less than is obtained when 20 c.c. of the potash solution is used for saponifying the fat, or when 5 c.c. are added to the soap solution before making up to 500 c.c. This is due to the difference in the volume of the solutions.

Whether the age of butter has any influence upon the viscosity of its soaps has not been definitely determined, as this would require a second examination of a sample of butter after considerable interval had elapsed. It is, however, quite certain that tnere can be no increase of viscosity from this cause, as those butters which have shown the lowest viscosity have been quite old.

BUTTERS.

	MAKER.	BREED OF COW	VISCOSITY OF SOAP SOLUTIONS MADE WITH				
			15 cc. K O H Sol.	20 cc. K O H Sol.	25 cc. K O H Sol.	30 cc. K O H Sol.	35 cc. K O H Sol.
1	Station, June 1886	Natives & Jerseys	65	72	124	290	521
2	"	" "	......	75	146	325	555
3	"	" "	......	......	161	362	......
4	"	" "	......	......	......	476	......
5	" October	" "	......	......	182	......	......
6	"	" "	......	......	180	......	......
7	"	" "	......	......	185	......	......
8	" November	" "	......	......	196	......	......
9	" Cooley, November.	" "	79	81	162	......	......
10	" Centrifugal "	" "	80	79	154	......	......
11	"	" "	72	82	181	......	......
12	" Colored, November	" "	81	86	152	......	......
13	" " 2 drops co	" "	82	89	174	......	......
14	" " 4 " "	" "	83	89	153	......	......
15	Valency Fuller	Jersey.	......	111	333	589	......
16	" "	"	80	123	322	......	......
17	" "	"	......	......	353	......	......
18	Miller & Sibley, Franklin, Pa	"	77	173	......	......	......
19	" " " "	"	......	168	479	......	......
20	Prof. Roberts, Ithaca, N. Y.	Native, Holsteins and grades.	81	188	528	......	......
21	" " " "		......	......	515	......	......
22	Smiths, Powell & Lamb, Syra	Holstein.	......	405	*	......	......
23	" " " "	"	80	391	......	......	......
24	Wright Stock Farm, Lockport, N. Y.	"	84	266	618	......	......
25	2087 Bay State Fair	Jersey.	72	167	......	......	......
26	" " " "		72	142	405	......	......
27	" " " "		......	145	405	......	......
28	2014 " " "	Natives & Grades	79	203	545	......	......
29	2049 " " "	Jersey.	84	123	340	......	......
30	2061 " " "	Durhams & Jer.	79	186	486	......	......
31	2078 " " "	Guernsey.	83	104	273	......	......
32	2096 " " "	Jersey.	77	114	322	......	......
33	2098 " " "	"	75	100	240	......	......
34	2101 " " "	"	80	83	233	......	......
35	F. Bronson, Southport, Ct., 17 months old, June 1885		70	78	126	......	......
	Average		78	145	289	......	......
	ADULTERATED BUTTERS AND OILS.						
36	Butterine, Armour & Co.		496	*	......	......	......
37	"		556	*	......	......	......
38	"		514	*	......	......	......
39	" Ross, Henshaw & Co		367	*	......	......	......
40	Oleomargarine		543	*	......	......	......
41	"		600	*	......	......	......
42	Neutral Lard		650	*	......	......	......
43	Oleo.oil		600	*	......	......	......
44	Butter Color, Richrrdson		*	......	......	......	......
45	" " "		*	......	......	......	......
46	" "Thatcher		300	......	......	......	......
47	Sesame oil		450	*	......	......	......
48	Cottonseed oil		315	*	......	......	......
49	Olive oil		508	*	......	......	......
50	Cocao oil		*	......	......	......	......
51	Palm oil		378	*	......	......	......
52	Castor oil		86	90	93	96	......
53	Cocoanut oil		84	87	90	91	......
54	Linseed oil		83	244	*	......	......
55	Insoluble fatty acids from Station butters		74	74	164	......	......
56	Insoluble fatty acids, Nos. 5, 6 7		80	87	118	......	......
57	" " " Nos 25 to 34		87	97	200	......	......
58	Insoluble fatty acids, Nos 20-21		77	96	241	......	......
59	" " " " 22-23		80	190	485	......	......
60	Stearic acid		*	......	......	......	......
61	Oleic "		194	543	*	......	......
62	Butyric "			......	......	70	......
63	40 per cent Oleic acid 47 " " Stearic " 7.5 " " Butyric " 5.5 " " Glycerine		629	*	......	......	......

*Too viscous to test.

In this table the column headed 15 c.c. K O H, shows the viscosity of a solution of soap made from 20 grams of filtered fat with 15 c.c. of the standard solution of caustic potash made up to 500 c.c. The numbers in the next column headed 20 c.c. K O H solution, represent the viscosity of the same solution tested for the preceding column, to which 5 c.c. of the standard potash solution have been added. The same is true of the column headed 25 c.c. and 30 c.c. In those cases where no numbers appear in the preceding column, the total amount of potash indicated was added before the solution was made up to 500 c.c. It would therefore be slightly less concentrated than where potash was added to a solution previously tested, and as a rule the viscosity has been correspondingly increased. When a concentrated solution of potash is added to a solution of soap at 20°C. a portion of the soap is gelatinized and precipitated, and in order to dissolve this portion, heat must be applied. This will, of course, evaporate a portion of the water and change the volume a little from that indicated by the amount of potash added. The last test in a series of this kind is therefore subject to a considerable error from this cause. If strictly accurate results are desired the potash should be added in every instance before the solution is made up to the required volume.

In the above table the tests joined by a brace are from the same sample of butter. The sample represented in tests 1, 2, 3 and 4 was made in June when the cows were in flush feed. This sample had been kept in a warm room for several months and had become quite rancid. Sample 35, which was nearly a year and a half old, was made from the milk of a single cow in pasture, and had also become rancid. The viscosity of these samples is lower than any other examined. I am inclined to think, however, that this is due to the character of the food and not to the condition of the butter.

The butters used for tests 9 and 10 were made from the same milk, the cream for 9 being separated by a Cooley creamer and 10 by a centrifugal. Nos. 15, 18, 22, 24, 25 and 28 were also made from cream separated by the centrifugal. There is apparently no difference in butters made from cream separated in this way and that separated by setting the milk.

For the purpose of determining the effect of the butter colors upon this test the churning of Nov. 20 was colored with Richardson's butter color, the quantity recommended being used. This butter is test No. 12. No. 11 is from the previous churning and uncolored. No. 13 is from the same butter as No. 12, but had 2 drops of Hensen's butter color in the 20 grams of filtered fat taken. No. 14 same butter with 4 drops of color added. These tests showed no marked difference between butters colored and uncolored.

The viscosity is practically the same for all of the butter soaps when 15 c.c. of potash solution is used, the average for the tests in this table being 78, the maximum 84 and the minimum 65. There seems to be no difference which can be attributed either to breed of cow or to methods of manufacture. In the second column with 20 c.c. of potash solution the difference in the butters is very marked, the average being 145, with a range of from 72 to 405. The difference with 25 c.c. is still more decided, the average being 289, with a range from 124 to a point where the sotion was too viscous to be determined by the apparatus as arranged.

With this amount of alkali the Holstein butters are decidedly more viscous than any others, but the number of samples examined was not sufficient to establish this as a breed characteristic. The two samples of Holstein butter tested were of prime quality and would compare favorably both in appearance and flavor, with the best samples tested. The cause of this difference is difficult to trace. I supposed at first that it could be attributed to varying quantities of butyric acid, this being the one constituent which pre-eminently distinguishes butter from the other animal fats. This, however, can scarcely be the case, as examinations of the following butters by Reichert's test show. The amount of decinormal soda required by this test was, for No. 11=13.9 c.c., No. 18=13.6 c.c., No. 23=13.2 c.c., and for No. 25 =14.6 cc. These numbers should be proportional to the butyric acid in the butters, but they evidently have no relation to the viscosities found.

Contrary to the prevailing opinion of chemists, it seems certain that the fatty acids of butter have properties different from the corresponding acids derived from other fats. Stearic acid from tallow when treated with 15 cc. of K O H solution gave a soap which was a thick jelly at 20°C. Oleic acid gave a very viscous soap. Twenty grams of butyric acid required more than 15 c.c. of potash solution to neutralize it. With 30 c.c. it showed about the same viscosity as butter with 15 c.c. and was not materially increased by addition of more. Palmitic acid was not examined, but there is every reason to think that it would behave in nearly the same way as stearic. A mixture of these acids, excepting the last, made in nearly the proportion occurring in butter gave a soap that was extremely viscous, see test 63. On the other hand the insoluble acids from several of the butters gave soaps less viscous than the butters from which they were obtained, although they differed in the same way as the butters. It is evident that the stearic and oleic acids of butter differ in some way from the same acids derived from other sources, as an amount of either of these acids equivalent to that contained in one of the above tests would give a soap more viscous than the butter. It is probable that the acids of butter are isomers of those from other fats.

The only oils examined whose soaps are not rendered more viscous by the addition of alkali are castor oil and cocoanut oil, the change in these being very slight. The investigation of this subject is by no means complete, but it is thought best to present the results thus far obtained. So long as my trials were confined to a few butters, mostly from the station, I supposed that the method was capable of detecting adulterations with oleo-oil or neutral lard which would not exceed one or two per cent. The large variations shown in later tests present this. I believe, however, that it provides a simple and expeditious means for the detection of commercial adulterations, and that it will show as small a proportion of adulterations as any method at present employed.

The butters which I have been able to obtain may not show the extreme variation, but I think that no genuine butter will be found that will form a soap with 15 and 20 c.c. of potash solution exceeding in viscosity 90 and 400 respectively.

The butterine and oleomargarine whose tests are given were obtained from leading manufacturers and dealers, and were of the best quality. The tests given above are only a few from a large number made, but selected because they are the only ones that have been tested in the same way as the butters. In no case, however, has a less viscosity been found for butterine or oleomargarine than is given in the table.

I propose to repeat these tests using soda instead of potash for saponifying the fats. As a much less soluble soap will be obtained in this way, it is not improbable that the difference in the viscosity of the solutions may be greatly exaggerated.

FERTILIZERS.

The station receives a number of fertilizers each year from parties desiring analyses and valuations. Comparatively few of these are examined at all. On account of this much dissatisfaction is evinced by parties who think themselves aggrieved. This usually arises either from a misunderstanding of the authority and obligations of the station in regard to fertilizer analyses or from the almost universal neglect on the part of the persons sending them to exercise proper care in taking samples and shipping them to the station. Contrary to the general impression this is not a "control station" and has no authority to take samples, so that all analyses made are for the accommodation of private parties. No analyses of fertilizer, are therefore undertaken when they conflict with the regular station work.

In regard to the samples received it is sufficient to say that not one-half of them are accompanied by an adequate description, and not more than one in ten are both described and shipped in a proper manner.

At one time six samples were sent in glass cans, these being placed together in a wooden box with no packing. When received five of the cans were broken and the contents mixed.

Another party sent two samples in a canvass bag, with the statement that the portion in the top of the bag was of one kind and that in the bottom of the bag another.

Three samples were sent in paper bags, all being placed together in a paper sack. When received all of the packages were broken, the contents mixed and mostly lost.

Another sample was sent through the mail done up in paper and attached to a postal card, the whole package weighing one ounce, including the card. The sender wished an immediate reply giving the analysis and value per ton.

Many more illustrations of the careless manner in which samples are sent might be given, but the above are sufficient.

There have been in all ten samples examined during the year, none of which are of general interest, except, possibly, the following:

	Moisture.	Total phosphoric acid	Potash K_2O.
Canada unleached ashes	7.30	2.81	6.50
Muriate of potash			50.00

Canadian apatite contained 93.65 per cent. of calcium phosphate.

LYSIMETER.

The results of the analyses of water from the three lysimeters are still confusing, and no attempt is made to discuss them. Before they can be satisfactorily explained more must be learned concerning the movement of water in the soil.

We give on opposite page the figures in full for the past season and a summary of those for preceding years.

LYSIMETER NO. 1, 1886.— SOD.

	Rainfall. Inches.	Drainage. Inches.	Solids. Grains per gal.	Chlorine. Grains per gal.	Nitrogen as ammonia. Parts per million.	Nitrogen as nitrates. Parts per million.	Total nitrogen. Parts per million.
January	1.131	1.24	10.2	1.1	.0694	tr.	.069
February	.951	1.015	9.1	.9	.041	0	.041
March	1.13	1.387	10.2	.75	tr.	0	....
April	4.131	2.49	10.	.5	.0425	0	.0425
May	1.921	0	......	......	......	......	....
June	2.92	0	......	......	......	......	....
July	4.411	0	......	......	......	......	....
August	2.86	0	......	......	......	......	....
September	2.31	1.35	19.8	1.	.1073	tr.	.107
October	1.39	0	......	......	......	......	....
November	3.48	.025	......	......	......	......	....
December	1.24	.05	......	......	......	......	....
LYSIMETER NO. 2, '86. BARE SOIL							
January	1.131	1.28	60.2	1.5	.0554	122.21	122.26
February	.951	1.14	46.2	1.1	.025	195.	195.02
March	1.13	1.62	57.8	1.4	.0459	110.3	110.35
April	4.131	2.55	69.2	1.5	.0985	148.6	148.70
May	1.921	.003	......	......	......	......	....
June	2.92	.44	73.4	1.75	.458	177.9	178.36
July	4.411	1.405	66.4	1.3	.0375	134.8	134.84
August	2.86	.14	61.8	1.4	.0441	95.5	95.54
September	2.31	.175	70.0	1.8	0	33.3	33.30
October	1.39	.525	69.6	1.5	.0457	25.9	25.95
November	3.48	.279	49.8	1.	.1008	113.23	113.33
December	1.24	.32	53.8	1.	tr.	117.35	117.35
LYSIMETER NO. 3, 1886. CULTIVATED SOIL.							
January	1.131	1.13	50.	1.	.0784	113.2	113.28
February	.951	.33	41.72	.9	.016	139.	139.02
March	1.13	.78	45.4	.8	.0495	89.5	89.55
April	4.131	2.35	46.4	.75	.0579	95.5	95.56
May	1.921	.43	43.8	.7	tr.	81.6	81.60
June	2.92	.62	44.2	.5	.0177	112.5	112.52
July	4.411	1.77	43.8	.6	tr.	79.3	79.3
August	2.86	4.25	46.8	.75	tr.	90.6	90.6
September	2.31	.32	41.4	.7	tr.	80.6	80.6
October	1.39	.525	40.6	.5	tr.	113.9	113.9
November	3.48	2.645	32.4	.5	tr.	66.407	66.41
December	1.24	.32	35.	.4	0	73.52	73.52

The following table shows, in tons per acre, the amount of rainfall and the drainage water from each of the three lysimeters, the weight of one inch of water per acre being 112.98 tons.

1886.	Rainfall: tons per acre.	Drainage; tons per acre.			Loss of nitrogen: ℔s. per acre.		
		No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.
January	127.78	140.10	144.61	127.66	.019	35.37	28.81
February	107.44	114.67	128 80	37.28	.009	50.24	10.42
March............ ..	127.66	156.70	183.03	88.12	——	40.26	15.75
April	466.72	281.32	288.10	265.50	.024	85.82	50.76
May	217.03	0	.34	48.58	——	——	7.91
June	329.90	0	49.71	70.05	——	17 62	15.82
July.................	498.35	0	158.74	199.97	——	42.79	31.72
August	323.12	0	15.82	48.02	——	2.98	8.64
September	260.98	152.52	19.77	36.15	.032	1.29	5.83
October............	157.04	0	28.47	59.31	——	3.09	13.57
November	393.17	2.82	315.21	298.27	——	71.44	39.69
December....	——	——	——	——	——	——	——
	140.09	5.65	36.15	36.15	——	8.45	5.29

	Rainfall: inches.	Drainage: inches.			Loss of nitrogen per acre: ℔s.		
		No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.
Total 1883.........	25.894	3.748	8.248	11.509			
" 1884.	22.30	3.646	5.168	5.988	.192	69.534	132.24
" 1885.........	23.95	.357	7.088	10.989	1.02	218.7	218.2
" 1886.........	27.87	7.556	12.115	11.64	.084	357.7	234.10

SUNSHINE RECORD.

The daily record of sunshine commenced May 1, 1885, has been continued without intermission through the present year. Observations of this kind, extending as they do over only two years, do not give sufficient data for a discussion of this subject. Still a comparison of the monthly records for these years is interesting. The total number of hours for each month from May 1 to November 1, for two years is given.

	May	June	July	Aug.	Sept.	Oct.	Total
1885	165	237	285	163	207	134	1191
1886	236	252	243	240	200	143	1314
Excess for 1885	...	...	42	...	7	...	....
Excess for 1886	71	15	...	77	...	9	123

The total excess for 1886 is nearly half as much as was received during any one month.

The average temperatures derived from three observations each day for these periods were:

	1885	1886
May	57.27	58.1
June	66.33	67.3
July	72.31	70.9
Aug	65.76	69.2
Sept	60.37	63.1
Oct	48.95	50.8

It is evident that the temperature has been nearly proportional to the sunshine, and there is little doubt that when sufficient data are at hand, some relation will be traced between sunshine and plant development. It is not improbable that the difference in the maturity of late crops, especially corn and grapes, for 1885 and 1886 may be largely due to the difference in sunshine.

The results of our observations are presented below.

1885.	Before 9 a. m.	9-12	12-2	After 3 p. m.	Total.
May—Total hours	41-45	44-15	40-45	38-15	165.
Per cent. of possible sunshine	30.8	47.6	43.8	29.0	36.4
June—Total hours	63-15	58-30	54-30	59-15	237-30
Per cent. of possible sunshine	47.1	65.0	60.5	42.7	52.0
July—Total hours	64-45	55-45	61-45	66 30	284-45
Per cent. of possible sunshine	47.9	60.	66.4	47.2	53.8
August—Total hours	43-00	42-45	39-45	38-00	353-30
Per cent of possible sunshine	36.0	46.0	42.7	30.8	38.1
September—Total hours	43-15	58 45	38.00	46 45	206-45
Per cent. of possible sunshine	43.5	65.3	64.4	49.6	55.3
October—Total hours	20-00	39-15	44-30	30-45	134-30
Per cent. of possible sunshine	25.7	42.2	47.8	39.5	39.3
November—Total hours	6-15	17-00	22-00	7-45	53-00
Per cent. of possible sunshine	11.0	19.0	24.7	13.7	18.1
December—Total hours	5-00	21-15	20-00	3-45	50.00
Per cent. of possible sunshine	9.0	22.8	21.5	8.2	17.6

Date.	Before 9 a. m.	9-12	12-3	After 3 p. m.	Total.
January 1	0	0	0	0	0
“ 2	0	1–30	0	0	1–30
“ 3	0	0	0	0	0
“ 4	0	0	0	0	0
“ 5	0	0	0	0	6
“ 6	0	0	0	0	0
“ 7	0	0	–15	0	0
“ 8	0	0	0	0	0
“ 9	0	0	0	0	0
“ 10	0	0	0	0	0
“ 11	0	1–45	0	0	1–45
“ 12	–30	3–00	1–45	–15	5–30
“ 13	–45	3–00	3–00	1–15	8–00
“ 14	1–0	3–00	3–00	1 45	8–45
“ 15	–30	2–00	–30	0	3–00
“ 16	0	0	0	0	0
“ 17	–15	–45	0	0	1–00
“ 18	0	0	0	0	0
“ 10	0	0	0	0	0
“ 20	–45	1–00	0	0	1–45
“ 21	0	0	0	0	0
“ 22	0	0	2–30	–15	2–45
“ 23	1–00	1–15	–15	0	2–30
“ 24	0	–30	3–00	1–30	5–00
“ 25	0	0	0	0	0
“ 26	0	0	0	0	0
“ 27	0	–45	0	0	–45
“ 28	0	0	0	0	0
“ 29	0	0	0	0	0
“ 30	0	–15	–30	0	–45
“ 31	0	0	0	0	0
Total for January	4–45	18–45	14–45	5–00	43–15
Per cent. of possible sunshine	8.2	20.2	15.9	8.7	14.3
February 1	0	0	0	0	0
“ 2	0	1–15	1–30	0	2–45
“ 3	0	–15	1–30	–15	2–00
“ 4	0	0	0	0	0
“ 5	0	2–30	2–45	–30	5–45
“ 6	0	0	0	0	0
“ 7	0	0	0	0	0
“ 8	2–0	3- 0	3–0	2–0	10–0
“ 9	1–45	3–0	1–45	–15	6–45
“ 10	–45	2–30	2–45	30	6–30
“ 11	0	0	0	0	0
“ 12	0	0	-30	0	–30
“ 13	0	0	0	0	0
“ 14	0	0	0	0	0
“ 15	0	0	0	0	0
“ 16	1–15	2–30	2–30	1–0	7–15
“ 17	1–45	3–0	2–15	0	7–0
“ 18	–30	3–0	2–0	0	5 30
“ 18	0	0	0	0	0
“ 20	0	0	–15	–30	–45
“ 21	0	0	0	0	0
“ 22	0	1–0	–15	1–30	2–45

Date.	Before 9 a. m.	9-12	12-3	After 3 p. m.	Total.
February 23	0	0	1–0	–30	1–30
" 24	1–30	3–0	2–0	0	6–30
" 25	0	0	0	0	0
" 26	0	0	0	0	0
" 27	0	1–30	1–45	1–0	4–15
" 28	2–15	3–0	3–0	2–0	10–15
Total	11–45	29–30	28–45	10–	80–00
Per cent of possible sunshine	17.9	35.1	34.2	15.2	26.7
March 1	1–30	2–15	–30	0	4–15
" 2	0	0	0	0	0
" 3	0	0	0	0	0
" 4	–15	1–00	0	6	1–15
" 5	0	–30	3–00	2–45	6–15
" 6	0	1–00	3–00	2–00	6–00
" 7	1–45	1–00	–15	–15	3–15
" 8	0	0	0	0	0
" 9	0	0	0	0	0
" 10	0	0	1–00	1–45	2–45
" 11	2–00	3–00	2–15	–45	8–00
" 12	0	0	0	0	0
" 13	0	0	0	0	0
" 14	–15	1–45	2–15	0	4–15
" 15	1–00	3–00	3–00	1–15	8–15
" 16	0	0	0	–15	–15
" 17	0	0	–45	1–45	2–30
" 18	0	0	0	0	0
" 19	0	0	0	0	0
" 20	0	0	1–15	0	1–15
" 21	0	1–15	–30	0	1–45
" 22	0	0	0	0	0
" 23	0	0	0	0	0
" 24	2–15	3–00	3–00	2–00	10–15
" 25	0	1–15	1–00	0	2–15
" 26	2–15	3–00	3–00	1–45	10–00
" 27	–30	0	0	0	–30
" 28	2–15	3–00	3–00	2–00	10–15
" 29	0	0	0	0	0
" 30	0	0	0	0	0
" 31	0	0	0	0	0
Total	14–00	25–00	27–45	16–30	83–15
Per cent. of possible sunshine	15.0	26.9	29.8	17.6	22.3
April 1	2-15	2-00	0	-15	4-30
" 2	-15	0	-15	-15	-45
" 3	-30	1-30	-15	-45	3-00
" 4	-15	0	0	0	-15
" 5	-30	3-00	1-15	0	4-45
" 6	0	0	0	0	0
" 7	0	0	0	0	0
" 8	-15	2-45	3-00	2-15	8-15
" 9	2-30	3-00	3-00	2-15	10-45
" 10	1-00	1-30	1-45	-45	5-00

Date.	Before 9 a. m.	9-12	12-3	After 3 p. m.	Total.
April 11	0	0	1-00	0	1-00
“ 12	0	0	-15	-15	-30
“ 13	0	0	-15	0	-15
“ 14	0	0	2-30	2-30	5-00
“ 15	2-30	3-00	3-00	1-45	10-15
“ 16	2-45	3-00	3-00	2 30	11-15
“ 17	2-30	3-00	3-00	2-00	10-30
“ 18	2-30	3-00	3-00	2-00	10-30
“ 19	2-30	1-30	0	1-30	5-30
“ 20	2-30	3-00	3-00	2-00	10-30
“ 21	2-45	3-00	1-45	0	7-30
“ 22	1-30	3-00	2-30	0	7-00
“ 23	2-30	2-00	0	0	4-30
“ 24	0	0	0	0	0
“ 25	0	0	0	0	0
“ 26	0	0	0	-15	-15
“ 27	0	0	0	2-15	2-15
“ 28	1-45	3-00	2-45	3-00	10-30
“ 29	2-45	2-45	-30	1-45	7-45
“ 30	2-30	-30	0	0	3-00
Total	36-30	44-30	35-30	28 15	144-45
Per cent. of possible sunshine	33.4	49.4	39.5	25.8	36.3
May 1	2-45	2-30	3-00	-45	9-00
“ 2	2-15	3 00	3-00	3-15	11-30
“ 3	3-45	3-00	3-00	3-00	12-45
“ 4	2-00	-30	0	0	2-30
“ 5	1-45	0	-45	2-15	4-45
“ 6	3-15	3-00	2-45	4-00	13-00
“ 7	2-45	2-00	0	0	4-45
“ 8	0	0	-15	1-00	1-15
“ 9	3-00	2-15	1-45	-38	7-30
“ 10	0	0	0	0	0
“ 11	-15	-30	3-00	3-45	7-30
“ 12	3-15	3-00	3-00	3-45	13-00
“ 13	0	0	0	0	0
“ 14	2-00	1-00	1-00	-30	4-00
“ 15	0	0	0	0	0
“ 16	-30	0	-30	3-00	4-30
“ 17	3-00	3-00	3-00	3-00	12-00
“ 18	4-00	3-00	2-15	2-00	11-15
“ 19	2-45	3 00	3-00	3-30	12-15
“ 20	2-15	3-00	3-00	4-00	12-15
“ 21	3-15	3-00	2-45	-30	9-30
“ 22	-15	2-30	2-15	4-15	9-15
“ 23	2-30	3-00	2-30	-45	8-45
“ 24	3-15	2-45	-30	2-15	8-45
“ 25	-30	1-00	3-00	1-30	6-00
“ 26	0	-15	-30	4-00	4-45
“ 27	0	0	0	0	0
“ 28	3-15	3-00	2.45	3-30	12-00
“ 29	2-45	2-45	1-00	1-00	7-30
“ 30	3-00	3-00	3 00	2-45	11-45
“ 31	3-15	3-00	3-00	4-00	13-15
Total	61-30	57-00	54-30	62-45	235-45
Per cent of possible sunshine	46.0	61.3	58.6	46.9	51.9

Date.	Before 9 a. m.	9-12	12-3	After 3 p. m.	Total.
June 1	3-30	3-00	3-00	3-00	12-30
" 2	1-15	-15	-30	-45	2·45
" 3	-45	2-30	1-30	3-15	8-00
" 4	3-15	3-00	3-00	4-30	13-45
" 5	3-15	3-00	3-00	2-45	12-00
" 6	3-30	3-00	3-00	3-15	12-45
" 7	2.45	2-30	2-15	2-15	9-45
" 8	3-15	3-00	3-00	4-00	13-15
" 9	2-45	2-15	-15	0	5-15
" 10	2-15	3-00	2-15	3-15	10-45
" 11	2-45	3-00	3-00	4-00	12-45
" 12	3-30	2-45	0	0	6-15
" 13	2-30	3-00	3-00	3-00	11-30
" 14	0	1-45	2-00	3-15	7-00
" 15	2 00	1-45	3-00	3-00	9-45
" 16	1-15	0	-15	2-00	3-30
" 17	-15	-30	0	2-00	2-45
" 18	1-45	3-00	3-00	3-45	11-30
" 19	3-30	-45	2 00	4-00	10-15
" 20	3-45	2-30	2-00	1-00	9-15
" 21	0	0	1-15	1-45	3-00
" 22	0	0	0	0	0
" 23	0	0	0	0	0
" 24	-15	-30	0	0	-45
" 25	1-15	1-45	2-45	1-30	7-15
" 26	-15	0	1-00	3-15	4-30
" 27	2-00	3-00	2-45	3-30	11-15
" 28	3-45	3-00	3-00	4-15	14-00
" 29	3-15	3-00	3-00	3-15	12-30
" 30	3-30	3-00	3-00	4-15	13-45
Total	62-00	58-45	56-45	74-45	252-15
Per cent. of possible sunshine	44.8	65.3	63.1	54.0	54.2

July 1	3-45	3-00	3-00	3-30	13-15
" 2	1-00	1-00	1-00	3-15	6-15
" 3	3-00	3-00	3-00	3-30	12-30
" 4	3-00	3-00	3-00	3-45	12-45
" 5	3-15	3-00	3-00	3 45	13-00
" 6	2-45	2-00	2-00	2-30	9-15
" 7	0	1-00	1-00	3-45	5-45
" 8	3-45	3-00	3-00	4-15	14-00
" 9	1-00	1-00	0	1-15	3-15
" 10	3-00	3-00	2-45	3-00	11-45
" 11	1-45	1-15	3 00	4-00	10-00
" 12	3-30	2-45	2-15	3-15	11-45
" 13	2-45	2-45	2-00	-30	8 00
" 14	0	0	0	0	0
" 15	0	-30	-45	0	1-15
" 16	0	-30	-30	0	1-00
" 17	1-45	2-45	2-30	1-15	8-15
" 18	0	0	1-00	1-45	2-45
" 19	-30	0	-15	-15	1-00
" 20	0	1-45	2-30	2-45	7-00
" 21	2-30	3-00	2-00	1-30	9-00
" 22	-45	3-00	3-00	3-30	10-30
" 23	3-30	3-00	3-00	3-30	13-00

Date.	Before 9 a. m.	9-12	12-3	After 3 p. m.	Total.
July 24	3-00	3-00	3-00	3-00	12-00
“ 25	-15	2-00	2-15	-45	5-15
“ 26	0	0	0	0	0
“ 27	1-00	3-00	2-45	3-30	10-15
“ 28	3-00	3-00	3-00	1-00	10-00
“ 29	-30	0	1-45	2-15	4-30
“ 30	-15	2-30	3-00	2-00	7-45
“ 31	1-30	-30	2-15	4-00	8-15
Total	51-00	58-15	62-30	71-30	243-15
Per cent. of possible sunshine	36.9	62.6	67.2	51.8	52.6
August 1	3-15	2-30	0	.30	6-15
“ 2	2-45	3-00	3-00	2.15	11-00
“ 3	-30	1-45	2-15	3-45	8-15
“ 4	3-00	1-45	1-00	4-00	9-45
“ 5	2-45	1-00	0	0	3-45
“ 6	3-00	3-00	3-00	3-30	12-30
“ 7	1-15	1-15	2-00	-15	4-45
“ 8	3-00	3-00	3-00	3-15	12-15
“ 9	3-00	3-00	3-00	2-15	11-15
“ 10	3-00	3-00	2-00	3 30	11 30
“ 11	-45	2-15	2-30	-30	6-00
“ 12	2-45	1-15	2-45	3-30	10-15
“ 13	2-30	2-15	-15	1-00	6-05
“ 14	-30	-45	3-00	3-45	8-00
“ 15	3-30	3-00	3-00	3-30	13-00
“ 16	-15	0	0	0	-15
“ 17	0	0	0	0	0
“ 18	1-30	2-15	2-00	3-00	8-45
“ 19	3-00	3-00	3-00	3-30	12-30
“ 20	3 00	3-00	3-00	2-30	11-30
“ 21	-15	2-30	2-15	-45	5-45
“ 22	3-00	2-30	2.30	2-30	10-30
“ 23	0	0	0	0	0
“ 24	0	0	0	0	0
“ 25	-45	2-00	-30	3-15	6-30
“ 26	2-00	3-00	3-00	3-00	11-00
“ 27	2-30	3-00	3-00	3-00	11-30
“ 28	2-00	3-00	3-00	2-30	10-30
“ 29	2-00	3-00	3-00	2-30	10-30
“ 30	2-00	2-00	-15	0	4-15
“ 31	0	0	-45	1-30	2-15
Total	57-45	62-00	57-00	63-30	240-15
Per cent. of possible sunshine	47.6	66.6	61.3	52.3	56.0
September 1	2-15	1-30	2-45	3-30	10-0
“ 2	3-00	3-00	3-00	3-15	12-15
“ 3	3-00	3-00	2-45	2-00	10-45
“ 4	1-00	2-15	1-30	2-15	7-00
“ 5	0	1-15	2-45	2-00	6-00
“ 6	2-15	3-00	3-00	2-30	10-45
“ 7	2-00	3-00	3-00	2-30	10-30
“ 8	1-45	3-00	3-00	2-30	10-15
“ 9	0	1-30	2-45	1-30	5-45

Date.	Before 9 a. m.	9-12	12-3	After 3 p. m.	Total.
Septemb'r 10	-45	2-00	1-30	-30	4-45
" 11	2-15	3-00	3-00	2-30	10-45
" 12	0	0	0	0	0
" 13	2-00	3-00	3-00	2-30	10-30
" 14	0	1-45	1-45	0	3-30
" 15	2-15	3-00	3-00	-15	8-30
" 16	0	30	2-30	1-45	4-45
" 17	1-15	3-00	1-30	0	5-45
" 18	2-00	3-00	3-00	2-15	10-15
" 19	0	0	-15	0	-15
" 20	-45	2-30	3-00	1-15	7-30
" 21	1-45	3-00	3-00	-45	8-30
" 22	1-30	2-45	1-30	-30	6-15
" 23	-15	-30	2-15	2 15	5-15
" 24	-30	3-00	2-45	0	6-15
" 25	-15	0	2-45	2-00	5-00
" 26	0	0	0	0	0
" 27	-15	-15	-15	0	-45
" 28	0	-15	0	0	-15
" 29	1-30	3-00	3-00	1-30	9-00
" 30	1-30	3-00	3-00	2-00	9-30
Total	34-00	59-00	65-30	42-00	200-30
Per cent. of possible sunshine	35.1	65.5	72.9	43.4	53.7
October 1	-45	-15	1-30	-15	2-45
" 2	0	0	1-00	-30	1-30
" 3	1-45	3-00	3-00	2-15	10-00
" 4	-45	1-15	1-00	0	3-00
" 5	0	-45	0	0	-45
" 6	-45	2.30	2-45	1-45	7-45
" 7	0	1-30	3-00	2-00	6-30
" 8	1-15	3-00	3-00	2-45	10-00
" 9	1-15	3-00	3-00	1-30	8-45
" 10	1-30	3-00	2-30	1-45	8-45
" 11	1-00	2-45	3-00	1-30	8-15
" 12	1-00	-15	0	0	1-15
" 13	0	0	0	-45	-45
" 14	-45	1-15	0	0	2-00
" 15	0	-15	-30	-45	1-30
" 16	-15	0	2-45	2-30	5-30
" 17	0	0	0	0	0
" 18	0	0	0	0	0
" 19	1-45	3-00	3-00	2-15	10-00
" 20	1-45	3-00	3-00	1-15	9-00
" 21	1-15	2-45	1-30	2-30	8-00
" 22	2-30	3-00	3-00	2-15	10-45
" 23	2-00	3-00	3-00	2-45	10-45
" 24	2-00	2-00	0	0	4-00
" 25	-45	-45	0	1-00	2-30
" 26	0	0	0	0	0
" 27	0	0	0	0	0
" 28	0	0	fi	0	0
" 29	0	0	0	0	0
" 30	0	0	0	0	0
" 31	1-00	2-30	3-00	2-15	8-45
Total	**24-00**	**42-45**	**43-30**	**32-30**	**142-45**
Per cent. of possible sunshine	**30.8**	**46.0**	**47.0**	**40.2**	**41.8**

Date.		Before 9 a. m.	9-12	12-3	After 3 p. m.	Total.
November	1	1-45	3-00	3-00	2-15	10-00
"	2	-15	2-00	2-30	1-30	6-15
"	3	-45	1-00	0	0	1-45
"	4	1-45	3-00	3-00	2-15	10-00
"	5	0	0	1-00	0	1-00
"	6	0	0	0	0	0
"	7	1-15	2-30	1-45	1-00	6-30
"	8	0	1-45	1-00	1-30	4-15
"	9	0	2-45	2-30	1-00	6-15
"	10	0	0	0	0	0
"	11	0	0	0	0	0
"	12	0	0	0	0	0
"	13	0	0	0	0	0
"	14	1-30	3-00	2-45	2-00	9-15
"	15	1-30	1-45	3-00	2-00	8·15
"	16	1-45	3-00	2-30	-30	7-45
"	17	0	0	0	0	0
"	18	0	-30	1-00	0	1-30
"	19	-15	-45	0	0	1-00
"	20	1-30	3-00	1-00	0	5-30
"	21	1-15	2-15	3-00	2-00	8-30
"	22	-30	3-00	-45	0	4-15
"	23	0	0	0	0	0
"	24	0	0	0	0	0
"	25	0	0	0	0	0
"	26	1 00	1-15	2-00	0	4-15
"	27	0	-15	-30	0	-45
"	28	-15	-30	-30	1-15	2-30
"	29	0	2-00	-30	0	2-30
"	30	0	0	0	0	0
Total		15-15	37-15	32-15	17-15	102-00
Per cent of possible sunshine		27.0	41.4	35.8	30.9	34.8

December	1	-45	1-00	0	0	1-45
"	2	0	-45	0	0	-45
"	3	1-15	-45	1-30	0	3-30
"	4	0	2-00	2-45	1-15	6-00
"	5	0	-45	3-00	1-30	5-15
"	6	-15	3-00	3-00	1-45	8-00
"	7	0	0	0	0	0
"	8	0	0	0	0	0
"	9	1-00	3-00	3-00	1-00	8-00
"	10	1-15	2-45	-45	-15	5-00
"	11	0	0	0	0	0
"	12	0	1-00	-45	0	1-45
"	13	0	0	1-00	-30	1-30
"	14	0	1-30	0	0	1-30
"	15	0	0	0	0	0
"	16	0	-15	2-00	1-00	3-15
"	17	1-00	2-45	1-45	-15	5-45
"	18	0	0	0	0	0
"	19	0	0	0	0	0
"	20	0	1-15	2-30	-45	4-30
"	21	0	0	0	0	0
"	22	0	0	0	0	0

Date.		Before 9 a. m.	9-12	12-3	After 3 p. m.	Total.
December	23	6	0	0	0	0
"	24	0	0	0	0	0
"	25	-45	2-15	0	0	3-00
"	26	0	0	0	0	0
"	27	0	0	0	0	0
"	28	-45	-30	2-00	0	3-15
"	29	0	-15	0	0	-15
"	30	1-00	1-30	2-30	-30	5-30
"	31	0	0	0	0	0
Total		8-00	25-15	26-30	8-45	68-30
Per cent. of possible sunshine		16.5	27.2	28.5	18.0	24.2

Report of the Assistant Chemist.*

AN EXAMINATION OF FEEDING-STUFFS.

During the past year my work, aside from the routine work incidental to the Station, has been mainly a continuation of the examination of our feeding-stuffs—their chemical composition and relative digestibility. When these are more fully studied it is hoped that some attention may be given to their physiological effects ; but before this can be satisfactorily done there is a necessity for a better knowledge of the work in hand and a means of measuring the relative digestibility of the other constituents of the feed—fat and nitrogen-free extract. Considerable time has been given to working out methods whereby this can be done. For measuring the digestible fat a process of saponification promised much with the coarse fodders, but with meal and similar products the difficulty of filtering has prevented its use, although it is hoped this may finally be overcome and thus a means found which will serve the purpose. With nitrogen-free extract an attempt has been made to measure its digestibility by diastatic fermentation.

The few experiments which time has permitted me to make in this direction, has offered so much of encouragement that the method will be further tested.

The processes pursued in the digestion of the albuminoids are the same as given in the last report, except that one gram of the substance is always used, as it can be worked to better advantage and is preferable to a larger quantity. In order to test what effect, in the digestion, each separate part of the digestion fluid has, a few experiments were made, also with different quantities of the fluid as commonly used. Water alone, water and HCl., as in regular digestion, water and pepsin, no HCl., different amounts of digestion fluid, and a digestion fluid containing twice the usual amount of pepsin, were used.

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*E. F. Ladd.

A few of the results are given in the following :

	Per cent. digested[1].
Water	36.90
Water and HCl	23.70
Water and pepsin	41.20
200 c.c. fluid	57.59
150 c.c. fluid	70.25
130 c.c. fluid	63 05
100 c.c. fluid	52.53
A strong fluid (twice the pepsin)	66.90

Corn meal was the substance digested in the above trials. We observe that the best result obtained was with 150 c.c. of fluid, and this has been my experience from the first. While the number of experiments made has not in all cases been sufficient to warrant the assumption that the exact strength and conditions for best results have been secured, yet it is evident that any great departure from it has failed to give as good results. When a small quantity of starch or sugar was added to the meal, the amount digested was diminished in proportion.

	Per cent. digested.
Corn meal	70.25
Corn meal and starch	67.30
Corn meal and sugar	54.45
Corn meal, starch and sugar	58.90

When 0.5 grams of egg albumen was tested, the whole was digested, but the addition of a little starch or sugar tended to diminish the digestibility.

	Per cent. digested.
Albumen	100.00
" and starch	88.51
" and sugar	99.15
" starch and sugar	98.16
" " sugar and oil	90.60

PANCREATIN DIGESTION.

In artificial digestion trials it is usually recommended to further continue the operation after the digestion with gastric juice, by means of a pancreatin solution, but my own experience with the pepsin method has failed to give so uniform or as high results on the whole as when the pancreatin digestion was omitted. With the coarse fodders—hay, straws, etc., in some cases a higher digestion coefficient was obtained, but in nearly every case with grains, and their manufactured products, a smaller coefficient was obtained, as is shown by the following with two different corn meals.

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[1] Strictly speaking, the heading "Per cent. digested," in this connection, is incorrect, for it is hardly proper to call the amount dissolved by water as digested, in the sense that pepsin digests the substance, but to enable us to more comprehensively tabulate the matter, this term is used.

	Per cent. digested. I	II
Pepsin digested	70.25	73.10
Pepsin and pancreatin digestion	54.45	62.50

After digestion with the pepsin the solution is decanted, a solution of commercial pancreation added and the digestion continued. Probably all of the digested albuminoids are not washed out of the substance before adding the pancreatin solution and there seems to be a kind of saponification of portions of the meal with the pancreatin solution rendering the whole very difficult of filtration, hence it cannot be properly washed, and much of the otherwise digested nitrogenous portion is left on the filter. This has proved so grave a source of error that I have found it advisable, in my experiments, not to continue the digestion by means of a pancreatin solution, for, at best, there is but a slight increase in digestibility for any of the fodders, with a probability of decreasing the digestion coefficient in many concentrated feeds.

THE DEGREE OF FINENESS.

A sample of corn was ground to different degrees of fineness for digestion. The first quite coarse, the second as usually found for feeding and the third portion much finer.

	Per cent. digested
Corn meal, coarse	52.10
Corn meal, ordinary	65.60
Corn meal, fine	73.10

A difference of twenty per cent. in digestibility between coarse ground meal and that ground fine. In one hundred pounds of the meal as fed, a difference of 1.71 pounds of digestible albuminoids. The same is probably true in animal digestion and when properly fed a much larger per cent. of fine ground meal should be digested than of coarse ground. The animal does not further masticate the meal but moistens it with saliva enough to permit of its being swallowed, when it at once passes into the digestive tract and when coarse, the digestive fluids of the stomach must fail to penetrate through the particles so fully. Especially this seems true of the meal made from the flint corns.

ROYAL STOCK FOOD.

A sample of this feed was furnished by Mr. Geo. Johnson, of Geneva, who spoke well of it as a feed for young stock.

An examination showed it to be mainly a mixture of cottonseed meal, corn meal, oat meal, linseed and bean meal with some caraway seed, while the agreeable odor was indicative of fenugreek, and a test for sodium chloride (common salt) showed unmistakably its presence.

Below are given the analyses.

	Fresh substance.	Calculated dry.
Water	14.00	
Albuminoids	23.38	27.19
Crude fiber	7.11	8.27
Nitrogen-free extract	45.30	52.66
Fat (Ether extract)	4.77	5.55
Ash	5.44	6.33
Per cent of albuminoids digested	83.39	

The vendor's catalogue states that it can be sold in Chicago at the factory for 26 to 28 dollars per ton.

Chemically we find it inferior to linseed meal, while its digestibility is less than that of the old process linseed meal examined, that giving 89.52 per cent as a digestion coefficient for the albuminoids.

MIXED FEEDS.

There is no doubt but what many feeding products—especially waste and by products—can be intimately mixed so as to produce a better balanced ration than when fed separately or supplementary to other feeds.

Whether such mixed feeds can be purchased in the markets, when made from good material, and for a less cost than they can be compounded by the farmer himself may be fairly questioned.

The mixing of aromatic and carminative substances with the feed seems by our results to be detrimental and such feeds had better be shunned by the farmer. There is good reason for thinking the most wholesome material is not always used but rather much refuse-stuff—heated and mouldy beans, heated corn, chaffy oats, etc.—for which there is no other profitable way of disposal. These, combined with cotton and linseed meal, and some aromatic substance, are disposed of in many instances at fabulous prices. Dr. Goessmann[1] calls attention to a so-called contrated feed selling at $8.00 per hundred weight, $160.00 per ton, which from a chemical standpoint is little better than corn meal.

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[1] Bulletin No. 20, Mass. Ag. Exp't Station.

PTOMAINES IN CORN MEAL.

I have already called attention to the subject of heated corn meal[1] and investigations by Husemann, Brugnatelli and Balbiano have shown[2] that such meals frequently contain a toxic (poisonous) principle belonging to the class ptomaines due to putrid decomposition of the nitrogenous portions of the corn meal. I have succeeded in isolating, by the Stas-Otto method, a small quantity of this poisonous principle from a sample of badly heated meal. This ptomaine, from an etheral solution, gave urea-like crystals on slowly evaporating. The solution gave many of the characteristic ptomaine reactions as follows: Potassio-ferriccyanide was reduced, also gold chloride. Ferric chloride gave a dirty greenish-yellow, platinic chloride a brownish-yellow, and potassio-mercuric iodide a yellowish-white precipitate. Phosphomolybdic acid gave an abundant lemon-yellow precipitate and on the addition of ammonia the solution became green. Iodine in iodide of potassium gave a burnt umber, or brownish-red precipitate, sulphuric acid after a little time gave a reddish-brown coloration.

I had intended to study the physiological effects of this ptomaine but have been unable to procure enough of the material to do satisfactory work so that I have been obliged to discontinue it for the present but shall again take it up at the first opportunity. The ill-effects sometimes arising from feeding cotton seed meal I suspect may be due to similar causes, but do not know that any attempt has been made to see whether ptomaines might not be present in such cases. This meal is so highly nitrogenous I suspect on fermentation ptomaines might be produced in considerable quantities, however, it does not necessarily follow that all heated or damaged meals contain ptomaines, since they are only one of the products of decomposition; or ptomaines having been formed they may again on further decomposition disappear, or be changed into other forms.

Ptomaines are not alone confined to the food of our domestic animals, but are found in many substances used for the food of man, when decomposition is allowed to set in before being used, and serious cases of poisoning have occurred from eating cheese[3] and milk which were unfit for use. In ice cream, particularly that containing gelatine, in canned meats and fruits when they are opened and exposed to the air for some time before being used these poisons sometimes are found.

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[1] Fourth annual report N. Y. Ag. Exp't. Station, p. 318.

[2] Fresenius Zeit. fur Chemie, Band XXIII, p. 451.

[3] Zeit. Physiol. Chemie. Band 10, p. 146.

BABBOTT FEED.

An analysis and digestion test of two samples of these feeds have been made. No. 1 was said to contain 91 per cent. corn meal and 9 per cent malt. No. 2 was said to be 75 per cent. corn meal and 25 per cent. of other grains including malt.

We give below the analyses of both for dry substance and calculated to actual water content.

	No. 1.	Calculated dry.	No. 2	Calculated dry.
Water	11.11		9.26	
Albuminoids	25.83	29.06	22.85	25.18
Crude fiber	6.47	7.28	10.79	11.89
Nitrogen-free extract	48.15	54.16	49.54	54.60
Fat (either extract	6.70	7.54	5.57	6.14
Ash	1.74	1.96	1.99	2.19
Per cent. of albuminoids digested	66.68		74.18	

The above feeds have the appearance of being waste products from a distillery, kiln dried.

NOTES ON TABLE NO 1.

It is noticeable that the per cent. of albuminoids in the grasses are rather lower on the whole than are usually assigned. I think this is due mainly to the sampling. The tendency is towards a better sample than the average, and the bulk of all the analyses of the grasses have been made by chemists from samples sent in to them by persons in different parts of the country. The analyses here given are from samples taken by myself in the field and are as fair an average of the plats from which they were taken as was possible to secure.

The grasses were cut for analyses during the latter period of bloom and were all at about the same stage of growth and include *the whole plant.* A part of those given in the last report have been included in this and are starred.

No. 62. A sample of bran from New York grown wheat.
No. 63. A sample of bran from Dakota. Hard spring wheat.
No. 65. A sample of middlings from same source as bran No. 62.
No. 66. A sample of middlings from same source as bran No. 63.
No. 75. Royal Stock Food furnished by Mr. Johnson of Geneva, and manufactured by W. M. Bachelford & Co., Chicago, Ill.

No. 76 and 77. Babbott feed. Nos. 1 and 2 from W. M. Babbott, Pittsburg, Penn. No. 1 was said to contain 91 per cent. corn meal and 9 per cent. malt. No. 2 to contain 75 per cent. of corn meal and 25 per cent. mixed grains, including malt.

No. 82 and 83 are samples of linseed meal manufactured at Buffalo, N. Y., and brought to the Station for examination by Mr. Maxwell of Geneva, who thought from the appearance that No. 82 was less valuable than No. 83. The reverse proves true from a chemical standpoint, and both are undoubtedly old process meals.

No. 84. A sample of barley malt from Nester's malt house, Geneva, N. Y.

With one or two exceptions the corn meals digested were made from flint corn, and those of this year were many of them made from corn that had heated in the bins, so that the digestion coefficient shows lower than the average for flint corns.

COMMON AND SCIENTIFIC NAMES OF GRASSES ANALYZED.

Sweet Scented Vernal	Anthoxanthemum odoratum.
Ox Eye Daisies	Leucanthemum vulgaris.
Buttercups	Ranunculus acris
Medium Red Clover	Trifolium pratense.
Alsike Clover	Trifolium hubridum.
White Clover	Trifolium repens.
Lucerne; Alfalfa	Medicago sativa.
Yellow trefoil	Medicago lupulina.
Wood Meadow Grass	Poa nemoralis.
Timothy; Herds Grass	Phleum pratense.
Bennett's Native Wild	Triticum repens, var; (?)
Fort Bellingham Grass	(?)
Reed Canary Grass	Phalaris arundinacea.
Tall Meadow Oat Grass	Avena elatior.
Orchard Grass	Dactylis glomerata.
Rough-stalked Meadow	Festuca elatior.
Meadow Fescue	Festuca pratensis.
Porcupine Grass	Stipa spartea.
Bokhara Clover	Melillotus alba.
Chess; Cheat	Bromus secalinus.

TABLE I.

	GRASSES.	FRESH SUBSTANCE.						DRY SUBSTANCE.				
		Water.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat, (Ether extract).	Ash.	Albuminoids	Crude fiber.	Nitrogen-free extract.	Fat, (Ether extract).	Ash.
1	Sweet Vernal	67.41	2.10	10.74	17.02	1.16	1.57	6.44	32.96	52.22	3.57	4.81
2	Ox Eye daisies	78.46	1.28	5.62	12.16	.89	1.59	5.94	26.10	56.47	4.11	7.38
3	Buttercups	79.20	1.56	6.24	10.56	99	1.45	7.50	30.00	50.72	4.76	7.02
4	Medium red clover	75.63	3.66	6.86	11.08	1.22	1.55	15.00	28.16	45.46	5.00	6.38
5	Alsike clover	77.29	3.66	5.32	10.76	1.02	1.95	16.12	23.45	47.36	4.50	8.57
6	White clover	78.23	4.42	4.70	9.44	1.42	1.79	20.31	21.60	43.33	6.52	8.24
7	Lucerne	56.73	7.01	14.81	16.25	1.73	3.77	15.50	34.24	27.57	4.01	8.71
8	Lucerne, 4th cutting	67.20	7.69	8.67	11.85	1.34	3.25	23.44	26.43	36.12	4.10	9.91
9	Bokhara clover	69.20	3.52	13.12	11.45	1.10	1.61	11.44	42.60	37.17	3.56	5.23
10	Bokhara clover, 2d crop before blm	80.55	3.04	6.79	7.22	1.13	1.27	15.63	34.94	37.11	5.81	6.51
11	Yellow trefoil	78.52	3.40	6.31	9.09	1.11	1.37	15.81	30.31	42.31	5.17	6.40
12	Timothy	71.36	1.34	8.56	16.54	.84	1.36	4.69	29.88	57.75	2.93	4.75
13	Wood meadow	55.55	2.86	16.29	21.82	1.32	2.16	6.44	36.65	49.29	2.98	4.64
14	Rough-stalked meadow	....	....	....	....	....	....	8.75	33.41	47.72	3.91	6.21
15	Bennett's native wild	57.62	3.31	16.30	19.44	1.45	1.88	7.81	38.46	45.87	3.41	4.45
16	Fort Bellingham	61.78	2.98	13.75	17.79	1.29	2.41	7.81	35.99	46.53	3.37	6.30
17	Reed Cannary	65.23	3.65	10.33	16.98	1.34	2.47	10.50	29.72	48.83	3.85	7.10
18	Fall meadow oat	69.07	2.09	10.76	15.46	1.01	1.63	6.75	34.78	49.94	3.27	5.26
19	Orchard grass	65.00	2.58	12.54	16.73	1.16	1.99	7.38	35.84	47.77	3.31	5.70
20	Meadow Fercue	68 70	2.44	10.93	14.82	1.14	1.97	7.81	34.93	47.34	3.63	6.29
21	Porcupine grass	59.04	3.97	13.74	19.61	1.34	2.30	9.69	33.54	47.88	3.28	5.61
22	Chess; Cheat	60.35	3.17	13.05	20.46	1.12	1.85	8.00	32.91	51.60	2.82	4.67
	GREEN FODDERS.											
23	Sorghum	83.43	1.04	5.76	8.56	.47	.74	6.25	34.74	51.69	2.85	4.47
24	"	84.58	.90	4.71	8.61	.38	.81	5.81	30.56	55.92	2.45	5.26
25	Fodder corn	70.74	2.45	11.40	12.74	.87	1.79	8.38	39.01	43.51	2.98	6.12
26	Ensilage	86.98	.72	5.11	5.90	.62	.67	5.51	39.28	45.36	4.74	5.11
27	"	86.07	.77	2.97	8.98	.52	.68	5.51	21.32	64.56	3.74	4.87
28	"	86.25	.93	4.79	6.42	.67	.94	6.75	34.81	46.60	4.92	6.85
29	* "	84.58	1.13	5.01	7.22	1.15	.91	7.31	32.48	46.84	7.45	5.92
	ROOTS AND TUBERS.											
30	Sweet potatoes	74.38	3.56	2.14	17.98	.60	1.34	13.90	8.37	70.15	2.35	5.23
31	Turnip flat	92.40	1.25	1.20	4.20	.23	.72	16.51	15.74	55.28	3.05	9.42
32	Cabbage. Outer leaves	89.86	1.83	2.98	3.51	.47	1.35	18.06	29.35	34.60	4.68	13.31
	HAYS.											
33	*Clover hay	14.53	11.80	28.22	25.84	3.31	6.30	13.81	33.02	42.13	3.86	7.18
34	*Same, exposed, average	14.53	10.42	35.14	33.28	2.48	4.15	12.19	41.11	38.95	2.90	4.85
35	*Same exposed, poorest	14.53	11.73	34.79	31.79	2.52	4.64	13.84	40.71	37.06	2.96	5.43
36	Hay, mixed	16.04	4.83	26.28	46.88	2.18	3.79	5.75	31.30	55.86	2.60	4.49
37	*Hay, mixed	15.22	5.14	31.28	41.36	2.06	4.94	5.94	36.89	48.91	2.43	5.83
38	*Hay, many daisies	16.85	4.94	35.89	35.58	2.08	4.66	5.94	43.16	42.80	2.50	5.60
39	Soja hispida	21.23	8.42	23.34	38.29	1.35	8 37	10.69	28.35	48.59	1.75	10.62
	STRAW.											
40	Wheat straw	17.86	2.98	42.74	31.04	1.22	4.16	3.63	52.14	37.68	1.48	5.07
41	Corn fodder	51.52	3.36	19.18	21.05	1.11	3.78	6.94	39.57	43.40	2.29	7.80
	GRAINS AND MEALS.											
42	Corn meal	12.88	9.90	2.81	68.87	4.16	1.38	11.37	3.22	79.05	4.78	1 58
43	Corn meal	25.55	7.36	2.64	60.41	3.16	.88	9.88	3.55	81.14	4.24	1.19
44	Corn meal, very poor	27.41	8.75	2.26	57.02	3.29	1.27	12.50	3.11	78.54	4.53	1.75
45	Corn meal	16.96	8.56	1.98	66.92	4.19	1.39	10.31	2.38	80.59	5.04	1.67
46	*Corn meal	12.21	10.86	2.24	68.23	5.06	1.40	12.37	2.55	77.78	5.77	1.59
47	*Corn meal	24.54	8.20	1.52	60.60	3.96	1.18	10.87	2.02	80.31	5.24	1.56
48	*Corn meal	8.01	9.61	2.14	73.80	4.98	1.47	10.41	2.33	80.35	5.41	1.50
49	*Corn meal	15.80	10.31	1.58	67.64	3.62	1.05	12.25	1.88	80.33	4.30	1.24
50	Corn meal	23.14	8.65	1.67	61.88	3.55	1.11	11.25	2.17	80.38	7.62	1.58
51	Corn flour							7.81	1.11	87.48	2.29	1.31
52	Corn meal, heated	22.56	9.83	2.42	61.53	1.95	1.71	12.69	3.13	79.45	2.52	2.21
53	Corn germ							13.44			17.93	4.85
54	Corn. Germ removed							10.19	1.36	87.56	.80	.59
55	Break flour, wheat							10.31	.73	87.37	1.20	.42
56	Patent flour, wheat							10.31	.67	87.83	.78	.41
57	*Pea meal	12.08	21.37	11.06	52.02	.86	2.61	24.31	12.58	59.17	.97	2.97
58	*Bean, navy	12.39	22.17	7.21	53.14	1.38	3.71	25.31	8.23	60.66	1.57	4.23
59	*Crushed oats	13.26	10.35	19.37	50.75	3.38	2.94	11.87	22 33	58.51	3.30	3.39
60	*Wheat, Clawson	12.80	13.00	3.76	67.40	1.64	1.40	14.93	4 31	77.28	1.88	1.60
61	Soja. hispida	8.06	40.22	7.81	26.94	12.27	4.70	43.75	8.50	29.29	13.35	5.11

	BY-PRODUCTS.	FRESH SUBSTANCE.						DRY SUBSTANCE.				
		Water.	Albuminoids.	Crude fibre.	Nitrogen-free extract.	Fat, (Ether extract).	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat, (Ether extract.	Ash.
62	Wheat bran	13.36	13.81	14.82	50.38	2.37	5.26	15.94	17.10	58.15	2.74	6.07
63	Wheat bran	9.27	16.05	12.26	52.11	3.74	6.57	17.69	13.51	57.44	4.12	7.24
64	*Wheat bran	13.72	13.69	10.52	53.09	2.86	6.12	15.87	12.19	61.53	3.32	7.09
65	Wheat middlings	13.77	15.60	4.42	57.68	4.83	3.65	18.44	5.13	66.54	5.66	4.23
66	Wheat middlings	9.44	17.99	4.70	59.90	4.22	3.75	19.87	5.19	66.14	4.66	4.14
67	Ship stuff	14.17	16.63	6.30	53.74	4.72	4.44	19.38	7.34	62.62	5.50	5.17
68	*Ship stuff	16.00	14.96	4.71	53.86	4.09	6.32	17.81	5.68	64.12	4.87	7.52
69	*Starch refuse, "wet feed,"	63.60	7.66	3.68	20.78	4.04	.24	21.06	10.10	57.08	11.11	.65
70	*Starch feed, "wet feed,"	65.50	4.31	4.29	22.46	3.26	.18	12.50	12 43	65.11	9.45	.51
71	*Gluten meal.	8.25	30.16	2.78	52.79	5.16	.86	32.87	3.03	57.54	5.62	.90
72	*Corn feed. ground germ	9.35	9.85	5.76	62 91	11.21	1.92	10.75	6.28	68.64	12.23	2.10
73	*Corn feed, ground hull	6.12	7.04	13.26	64.55	7.53	1.50	7.50	14.12	68.76	8.02	1.60
74	Corn cob	21.55	1.22	31.60	43.38	.24	1.55	1.56	40 28	55.88	.30	1.98
75	Royal Stock Food	14.00	23.38	7.11	45.30	4.77	5.44	27.19	8.27	52.66	5.55	6.33
76	Babbott Feed, No. 1	11.11	25.83	6.47	48.15	6.70	1.74	29.06	7.28	54.16	7.54	1.96
77	Babbott Feed, No. 2	9.26	22.85	10.79	49.54	5.57	1.99	25.18	11.89	54.60	6.14	2.19
78	*Cotton-seed meal	18.52	35.21	5.74	21.66	12.32	6.55	43.21	7.31	26.32	15.12	8.04
79	Cotton-seed meal	8.45	41.88	3.45	20.94	16.87	8.41	45.75	3·77	22.86	18.43	9.19
80	*Linseed meal, Old process	8.07	31.71	12.31	34.38	8.20	5.33	34.50	13.39	37.40	8.92	5.79
81	*Linseed meal, New process	8.55	32.35	13.77	38.13	2.13	5.07	35.37	15.06	41.70	2.33	5.54
82	Linseed meal	10.15	32.57	4.68	39.26	8.17	5.17	36.25	5.21	43.70	9.09	5.75
83	Linseed meal	10.53	31.02	11.46	31.85	9.72	5.42	34.68	12.79	35.61	10.86	6.06
84	Barley malt							13.63	6.78	75.39	2.46	1.74

ALBUMINOID AND NON-ALBUMINOID NITROGEN.

As there is a difference in value for feeding, between the albuminoid and non-albuminoid nitrogenous substances I have in most cases determined the total nitrogen and the true albuminoid nitrogen, taking the non-albuminoid nitrogen—amides, etc., by difference. These are given beyond and the per cent. of total nitrogen in the amide form, also with the grasses the date at which they were cut, all of which, except No. 10, were cut in bloom. The timothy was from a newly seeded field and taken from the mixed grasses as an average of the timothy for the field. With the exception of the daisies and buttercups the other grasses were all from the Station grass plats. For the determination of the albuminoid nitrogen, Stutzer's [1] cupric-hydrate method was used which in brief is as follows :

One gram of substance is placed in a beaker with 100 c.c. of alcohol and 1 c.c. of acetic acid, heated to a boil, cooled, then carefully decanted through a filter, leaving all the insoluble matter in the beaker, and well washed with warm alcohol to remove all acid. The residue is then covered with 100 c.c. of distilled water and heated to a boil, when partly cooled add from 0.3 to 0.4 grams hydrated copper oxide, it is then filtered through the same filter as the first and well washed. All the non-albuminoid nitrogenous matter is removed leaving on the filter only the albuminoid nitrogen, which in the tables given I have termed true albuminoids.

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[1] Zeit. fur Anal. Chemie. vol. XXI, part 4.

This method is not a perfectly satisfactory one, as has been demonstrated by Dr. Newbury[1] and others. J. M. Bartlett[2] found that when a larger quantity than 0.3 to 0.4 grams of cupric-hydrate was used better results were obtained, and this has been my experience. So that about 0.7 grams were added. When 0.7 grams cupric-hydrate are added the filteration is less difficult than with a smaller quantity, but the precipitate when dried is a very hard horn like mass, difficult of pulverization, and has been a source of difficulty in nitrogen determination by combustion. This difficulty is obviated by Kjeldahl's method, which has been found more satisfactory for all ordinary nitrogen determinations than the soda lime method.

ALBUMINOID AND NON-ALBUMOID NITROGEN.

Name.	Date.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Per cent of total nitrogen in amide form.
	Grasses.				
1 Sweet vernal	June 4	1.03	.97	.06	5.82
2 Ox-eye daisies	" 7	.95	.50	.45	47.37
3 Buttercups	" 7	1.20	1.13	.07	58.33
4 Medium red clover	" 9	2.40	1.92	.48	20.00
5 Alsike clover	" 9	2.58	2.05	.53	20.54
6 White clover	" 12	3.25	1.18	2.07	63.59
7 Lucerne	" 15	2.40	1.72	.68	28.33
8 Lucerne, 4th cutting		3.75	2.21	1.54	41.07
9 Bokhara clover	July 1	1.83	1.42	.41	22.40
10 Bokhara clover 2d crop (before bloom)		2.50	.94	1.56	62.40
11 Yellow trefoil	June 11	2.52	1.75	.78	30.83
12 Timothy	" 28	.75	.38	.37	49.33
13 Wood meadow grass	" 15	1.03	.87	.16	15.53
14 Rough-stalked meadow	" 19	1.40	.51	.79	56.42
15 Bennett's native wild	" 15	1.25	.86	.39	31.20
16 Fort Bellingham	" 15	1.25	.87	.38	30.40
17 Reed canary	" 19	1.68	1.30	.38	22.61
18 Tall meadow oat	" 9	1.08	.92	.16	14.81
19 Orchard	" 9	1.18	.44	.74	62.71
20 Meadow fescue	" 11	1.25	1.08	.17	13.60
21 Porcupine	" 19	1.55	1.23	.32	20.64
22 Chess or cheat	" 19	1.28	.43	.85	66.40
Average		1.73	1.13	60	35.61

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[1] Cornell University Experiment Station Report 1882-3.

[2] Maine State College Report, 1883, p. 25.

Name.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Per cent. of total nitrogen in amide form.
Green fodders.				
23 Sorghum	1.00	.71	.29	29.00
24 “	.93	.68	.25	26.88
25 Fodder corn	1.34	.90	.44	32.83
26 Ensilage	.85	.50	.35	41.17
27 Ensilage	.85	.45	.40	47.05
28 Ensilage	1.08	.75	.33	30.55
29 Ensilage	1.17	.73	.44	37.60
Roots and tubers.				
30 Sweet potatoes	2.23	1.47	.76	34.08
31 Turnip, flat	2.64	1.33	1.31	49.62
32 Cabbage, outer leaves	2.79	1.25	1.54	55.19
Hays.				
33 Clover hay	2.20	1.61	.59	26.81
34 Same exposed	1.95	1.50	.45	23.07
35 “ “	2.21	1.81	.40	18.09
36 Hay, mixed	.92	.79	.13	14.13
38 “	.95	.87	.08	8.42
39 Soja hispida	1.71	1.53	.18	10.53
Straw.				
40 Wheat straw	.68	.53	.15	22.06
41 Corn fodder	1.11	.84	.27	24.32
Grains and meals.				
42–50 Corn meal (average for nine)	1.80	1.34	.49	27.22
52 Corn meal heated	2.03	1.07	.96	47.29
53 Corn germ	2.15	1.82	.33	15.34
54 Corn, germ removed	1.63	1.26	.37	22.70
55 Break flour, wheat	1.65	.89	.76	46.06
56 Patent flour, wheat	1.65	.83	.82	49.69
57 Pea meal	3.89	3.83	.06	1.54
58 Bean, Navy	4.05	3.53	.52	12.83
59 Crushed oats	1.90	1.65	.25	13.16
60 Wheat, Clawson	2.39	1.41	.98	41.00
61 Soja hispida bean	7.00	6.34	.65	9.28
By-products.				
62 Wheat bran	2.55	2.05	.50	19.63
63 “ “	2.93	2.37	.46	16.25
64 “ “	2.54	2.08	.46	18.11
65 “ middlings	2.95	2.33	.62	21.01
66 “ “	3.18	2.30	.78	24.52
67 Ship-stuff	3.10	2.66	.44	14.19
68 “ “	2.85	2.37	.48	16.84
70 Starch feed, “wet feed”	2.08	2.11	–.03	.00
74 Corn cob	.25	.24	.01	4.10
78 Cotton-seed meal	6.93	6.44	.49	7.07
80 Linseed meal, old process	5.52	5.30	.22	3.98
81 “ “ new “	5.66	5.15	.51	9.01
82 Barley malt	2 18	1.60	.58	22.04

TABLE II.

DIGESTIBILITY.

No. corresponding to No. of analyses.	GRASSES.	Per cent. of crude albuminoids Nx6.25.	Per cent. of true albuminoid.	Per cent. undigested.	Per cent. of crude albuminoids digested.	Per cent. of true albuminoids digested.
1	Sweet Vernal	6.44	6.06	2.44	62.11	59.73
2	Ox-eye daisies	5.94	3.13	4.25	28.45	37.70
3	Buttercups	7.50	7.06	3.50	53.33	50.42
4	Medium red clover	15.00	12.00	5.25	65.00	56.25
5	Alsike clover	16.12	12.81	4.62	71.34	63.93
6	White clover	20.31	7.38	5.06	75.08	31.43
7	Lucerne	15.50	10.75	3.31	78.64	69.21
8	Lucerne, 4th cutting	23.44	13.81	5.12	73.59	62.92
9	Bokhara clover	11.44	8.89	2.69	76.48	69.74
10	Bokhara clover 2nd crop before bloom	15.63	5.88	3.37	78.44	42.66
11	Yellow trefoil	15.81	10.94	3.75	76.28	65.71
12	Timothy	4.69	2.38	2.06	56.08	13.44
13	Wood meadow	6.44	5.44	2.06	68.10	62.13
14	Rough-stalked meadow	8.75	3.81	2.50	71.43	34.38
15	Bennett's native wild	7.81	5.38	1.94	75.01	63.94
16	Fort Bellingham	7.81	5.44	1.81	76.82	66.72
17	Reed Cannary	10.50	8.13	2.75	73.81	66.17
18	Tall meadow oat	6.75	5.75	1.88	72.15	67.30
19	Orchard grass	7.38	2.75	2.44	66.93	11.28
29	Meadow Fescu	7.81	6.75	2.73	65.04	59.55
21	Porcupine grass	9.69	7.69	2.69	72.24	65.03
22	Chess, or Cheat	8.00	2.69	2.25	71.87	16.36
	GREEN FODDERS.					
23	Sorghum	6.25	4.44	2.63	57.92	40.76
24	Sorghum	5.81	4.25	2.50	56.96	41.17
25	Fodder corn	8.38	5.63	3.94	52.98	30.01
26	Ensilage	5.51	3.13	2.62	52.45	16.29
27	"	5.51	2.81	2.46	55.35	12.46
28	"	6.75	4.69	4.06	39.85	13.45
29	"	7.31	4.56	2.82	61.35	39.25
	ROOTS AND TUBERS.					
30	Sweet potatoes	13.90	9.19	5.44	60.86	40.80
31	Turnips, Flat	16.51	8.31	3.19	80.67	61.61
32	Cabbage, Outer leaves	18.06	7.81	3.00	83.39	61.59
	HAYS.					
33	Clover hay	13.81	10.03	3.62	73.75	63.91
34	Same, exposed, average	12.19	9.38	6.20	49.23	33.90
35	Same, exposed, poorest	13.84	11.31	7.09	48.76	37.31

TABLE II—(*Continued.*)

DIGESTIBILITY.

No. corresponding to No. of analysis.	HAYS.	Per cent. of crude albuminoids Nx6.25.	Per cent. of true albuminoids.	Per cent. undigested.	Per cent. of crude albuminoids digested.	Per cent. of true albuminoids digested.
36	Hay, mixed	5.75	4.84	3.13	45.56	37.39
37	" "	5.94	...	2.09	35.32	....
38	Hay, many daisies	5.94	5.44	2.51	57.69	53.86
39	Soja hispida	10.69	9.56	2.57	75.92	73.11
	STRAW.					
40	Wheat straw	3.63	3.31	2.75	25.27	16.91
41	Corn fodder	6.94	5.25	3.19	54.03	39.23
	GRAINS AND MEALS.					
42	Corn meal	11.37	8.44	3.37	70.37	60.06
43	" "	9.38	7.81	3.06	69.02	60.82
44	" " very poor	12.50	8.94	4.81	61.52	46.19
45	" "	10.31	7.81	3.37	67.32	56.85
46	" "	12.27	9.41	3.87	68.63	58.87
47	" "	10.87	8.31	1.50	86.15	81.95
48	" "	10.41	7.64	2.85	72.59	64.00
49	" "	12.25	8.81	3.57	70.86	59.48
50	" "	11.25	8.56	3.12	72.26	53.55
51	" flour	7.81	....	1.31	83.22	....
52	" meal, heated	12.69	6.69	3.38	73.36	49.47
53	" germ	13.44	11.38	3.56	73.51	68.71
54	" " removed	10.10	7.88	3.63	64.37	53.93
55	Break flour, wheat	10.31	5.56	1,06	89.71	80.93
56	Patent " "	10.31	5.19	1.13	88.07	78.22
57	Pea meal	24.31	23.93	2.75	88.69	88.46
58	Bean, Navy	25.31	22.06	1.13	95.59	94.93
59	Crushed oats	11.87	10.31	2.15	81.89	79.14
60	Wheat, Clawson	14.93	8.81	1.93	87.07	78.09
61	Soja hispida bean	43.75	39.63	2.56	95.52	93.79
	BY-PRODUCTS.					
62	Wheat bran	15.94	12.81	3.06	80.80	76.11
63	"	17.69	14.81	5.25	70.32	64.55
64	"	15.87	13.00	2.65	83.27	79.61
65	Wheat middlings	18.44	14.56	23 37	87.14	83.72
66	" "	19.87	14.38	2.44	87.72	83.03
67	Ship stuff	19.38	16.63	3.25	83.23	80.46
68	"	17.81	16.81	2.34	87.86	86.08

TABLE II—(*Continued*).

DIGESIBILITY.

No. corresponding to No. of analysis.	BY-PRODUCTS.	Per cent. of crude albuminoids Nx6.25.	Per eent of true albuminoids.	Per cent. undigested.	Per cent. of crude albuminoids digested.	Per cent. of true albuminoids digested.
69	Starch refuse, "*Wet feed*"	21.06	. .	5.60	73.43	...
70	" feed, " "	12.50	12.68	4.89	60.80	61.36
71	Gluten meal.	32.87	....	5.51	83.23	....
72	Corn feed, ground germ	10.75	...	4.54	57.98	....
73	Corn feed, ground hull	7.50	....	2.28	69.71	....
74	Corn cob	1.56	1.50	1.06	32.05	29.20
75	Royal Stock Food	27.19	....	4.38	83.39	....
76	Babbott Feed No. 1	29.06	...	9.68	66.68	....
77	" " " 2	25.18	...	6.50	74.18	....
78	Cotton.seed meal	43.21	40.25	5.30	87.73	86.83
79	" " "	45.75	...	8.44	81.56	....
80	Linseed meal, old process	34.50	33.13	3.61	89.52	89.10
82	" " new "	35.37	32.19	7.62	78.44	76.33
84	Barley malt	13.63	10.00	2.69	80.26	73.10

The clovers are far the richest in albuminoids of any of the hays, and a larger per cent of their albuminoids are digestible. Of the true grass family, so far as examined, the digestion coefficient does not vary far from 70 per cent.

Many farmers have considered ox-eye daisies as making a fairly good hay when cut early in bloom, but by analysis we find them inferior to the grasses, while the amount of albuminoids digested is very small, being but 28 per cent., little more than one-fourth of the total nitrogenous matter, and less than one-half the amount of any of the grasses. Hence how unprofitable it is to allow fields to produce a crop of these when there are so many valuable grasses which might be grown.

Buttercups are richer in albuminoids and nearly twice as digestible as the daisies.

The Soja hispida bean is the most highly nitrogenous of any of the vegetable foods analyzed, and no feed digested has as yet given so large a digestion coefficient; i. e., 95.32 per cent., while for the whole plant a digestion coefficient of 75.92 was obtained.

But a small per cent of the albuminoids of wheat straw was digested—25.27 per cent. The straw was of inferior quality, taken from a stack in the field during winter.

PEPSIN DIGESTION AND ANIMAL DIGESTION.

To show how close the digestion coefficients obtained by the Pepsin method accords to the actual digestion, made by the Germans, I give the following parallels for all similar substances tested.

	Pepsin method.	Kuhn's† German tables.
Red clover	65	67
Clover hay	74	70
Lucerne	78	77
Sorghum	58	56
Wheat straw	25	26
Pea meal	88	88
Oat meal	82	87
Bean meal	95	90
Cotton-seed meal	89	87
Wheat bran	83	98
Wheat bran	70	70
Corn meal	72	78 to 85
Linseed meal	89	87
Average for the above	74.46	74.69

The column from the German tables is the average of all their tests and not the result of single trials. It will be seen that in many instances, the results obtained by the Pepsin method agree as closely to actual digestion as could be expected had they been samples of the same fodder.

AN ILLUSTRATION OF THE POSSIBLE AID FROM ARTIFICIAL DIGESTION.

Chemical analyses shows us the potential, and not the nutritive value of a fodder. To make this more evident a few analyses are given by way of illustration.

	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.	Ash.
Ox-eye daisies	5.94	26.10	56.47	4.11	7.38
Hay	5.94	43.16	42.80	2.50	5.60
Buttercups	7.50	30.00	50.72	4.76	7.02
Clover hay	13.81	33.02	41.93	3.87	7.37
Same damaged	13.87	40.71	37.03	2.96	5.43

We observe but little difference in the amount of albuminoids between ox-eye daisies and the sample of hay, while in nitrogen-free extract and fat the daisies are far the richest, and from chemical analyses alone we would consider, for feeding, the daisies as superior to the hay. The same is true of the two clover hays* and yet one was a valuable feed while the other, although from the same lot, was so damaged by exposure as to be worthless. The cows refused to eat the damaged hay.

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†Armsby's Manual of Cattle Feeding.

*Bulletin No. 6, (New series) N. Y. Agr'l. Exp't. Station.

The digestibility of the albuminoids was determined by the pepsin method, and the information thereby obtained serves to place each fodder more nearly in the order in which it belongs as is shown by the following.

	Per cent. digested.
Ox-eye daisies	28.45
Hay	57.69
Buttercups	53.33
Clover hay	73.75
Same damaged	48.76

From the experiments of Dr. Jenkins[1] it would seem that it is possible we may by pepsin digestion find a means ot determining the relative availability of the nitrogen of different nitrogenous fertilizers. A few of the results obtained by Dr. Jenkins are repeated here from his report.

	Per cent of total nitrogen dissolved.
Blood No. 1	96.8
Blood No. 2	97.9
Leather	25.4
Horn shavings	22.4
Hair and leather	13.8
Wool waste	4.8

It certainly seems from the above that we have here a means of grading fertilizers according to the availability of their nitrogen. Such a classification would add much value to an analysis.

COMPOSITION OF DIFFERENT CUTTINGS OF GRASS.

In making fodder analyses my attention has frequently been attracted by the larger per cent of albuminoids in the second and subsequent cuttings of grass over that of the first crop, and a few of the analyses have been brought together here showing this difference.

Meliotus alba, (Bokhara clover).

	1st cutting.		2nd cutting.	
Water	69.20		80.55	
Albuminoids	3.52	11.44	3.04	15.63
Crude fiber	13.12	42.60	6.79	34.94
Nitrogen-free extract	11.45	37,17	7.22	37.11
Fat, (Ether extract)	1.10	3.56	1.13	5.81
Ash	1.61	5.23	1.27	6.51

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[1] Report Conn. Exp't. Station, 1885.

Mixed Grasses.

	1st cutting.	2nd cutting.	
Water		73.48	
Albuminoids	9.25	3.51	13.25
Crude fiber	41.51	10.45	39.40
Nitrogen-free extract	40.37	9.58	36.12
Fat, (Ether extract)	3.18	.98	3.68
Ash	5.69	2.00	7.55

Medicago sativa, (Lucerne).

	Water.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.	Ash.
1st cutting 1886	56.73	7.01	14.81	16.25	1.73	3.77
" " " dry		15.50	34.24	27.57	4.01	8.71
2nd cutting 1886	76.47	3.72	8.21	8.80	.84	1.96
" " " dry		15.81	34.91	37.34	3.59	8.35
4th cutting 1885	67.20	7.69	8.67	11.85	1.34	3.25
" " " dry		23.44	26.43	36.12	4.10	9.91

Leucanthemeum vulgaris, (Ox-eye daisies).

	1st cutting, 1886.		2nd cutting, 1883.	
Water	78.46		80 64	
Albuminoids	1.26	5.94	1.98	10.25
Crude fiber	5.62	26.10	5.09	26.29
Nitrogen-free extract	12.16	56.47	9.05	46.69
Fat, (Ether extract)	.89	4.11	1.09	5.64
Ash	1.59	7.38	2.15	11.13

We observe from the above that the per cent of albuminoids is considerably higher in each instance for the second cutting, and also the per cent of ash, while the variations in the other constituents are not marked. And further, there is shown what Wilson* has already called attention to, "That the difference in composition between different cuttings of the same grass is far greater than that between different grasses cut at the same stage."

FODDER ANALYSES.

CRUDE FIBER.

Probably in no other determination in fodder analysis is there likely to be so wide a variation in the results obtained by different chemists as in the fiber, due mainly to difference in methods used and degree of heat employed during the determination. As time has permitted, I have made a few trials for the purpose of ascertaing this difference. The results, with the methods employed, are given in this topic.

In all the methods, so far as I know, the strength of the acid and alkali used is the same, i. e., 200 c.c. of a 1.25 per cent. solution of each. For this reason it will not be necessary to repeat this with each method. For convenience in tabulating I have used letters to designate methods and variations.

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*Trans. Highland and Agric. Soc. Scotland, 1886; also J. of Chemical Soc. Ab., Oct., 1886, p. 906.

Method A.

The process employed at this Station has been fully described by Dr. Babcock in a former report* and in brief is as follows :

A half litre Erlenmyer flask is used and to the substance is added 200 c.c. acid solution, boil for one-half hour, filter through an asbestos filter (made by putting a platinum cone in a funnel, a small quantity of ignited asbestos and on this a little asbestos pulp) with aid of filter pump, wash thoroughly wilh hot water, transfer residue to flask, boil one-half hour with alkali, filter through asbestos filter, wash well with hot water, then with alcohol and finally with ether, dry at 100, ignite, loss on igniting is termed crude fiber. This method takes account of the ash but not of any remaining nitrogenous matter.

Method B.

Boil for one-half hour with acid, remove from heat, allow to fully settle, decant liquid, add 200 c.c. water, boil one-half hour, filter, adding any residue in decantation, return to flask, treat the same with alkali, boiling afterwards with water, filter, wash well with water, alcohol and ether, dry, weigh, ignite, loss is fiber.

Method C.

Boil with acid for one-half hour, allow to settle, decant liquid, leaving all solids in flask, add 200 cc. water, boil one-half hour, allow to settle, decant again, boil with 200 cc. of water for one-half hour, let settle, decant, leaving solids in flask and return any solids that may have passed off in decanting, treat with alkali and water as with acid finally filtering, dry and ignite. Here some divide the residue and determine the nitrogen in one portion and deduct the albuminoids found from total crude fiber. This method gives a fiber more nearly pure than either of the others since it takes account of both ash and any nitrogenous matter. There are some slight variations in the details of this method by different workers.

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*Second Annual Report, 1883, p. 166.

Method D.

Boil with acid one-half hour, allow to settle, siphon off fluid, add 200 cc. water, boil one-half hour, allow to settle, siphon off fluid putting with first, add 200 cc. water, boil one-half hour, let it settle, siphon off liquid with the first saving the whole ; to the residue in the beaker or flask add the alkali and repeat the operation as with acid, at last filtering, and having siphoned or decanted off the most of the liquid from the alkaline decantation return the last with the small amount of solids to the filter, wash until no longer alkaline, then add any residue from beaker containing acid decantation, wash the whole upon the filter until no longer acid, then wash with alcohol and ether. They then proceed as in the previous ones.

Method E.

A method which in print, illustrated by figures, looks perfection, but in practice a failure, is that with fiber bulbs. Thin glass globes terminating at the bottom in a funnel tube and open at the top to admit a cork bearing a glass tube and a second opening to allow of escape of steam. In the globe are put a platinum cone and asbestos filter, the whole carefully dried and weighed, then a known quantity of the substance to be examined is added and 200 c.c. of acid solution put in and the whole kept hot by passing steam into the solution, after one-half hour it is filtered with aid of a filter pump and treated in the same manner with an alkali, then washed successively with water, alcohol and ether. The globe, containing the fiber is now dried and weighed, the increase in weight is crude fiber. No account of ash or nitrogenous matter is taken by this method.

Besides the methods tested I made a few trials to determine the influence of the degree of heat employed in the fiber determinations. In the column marked F the solutions were first brought to a boil then put on the steam bath for the remainder of time, otherwise the same as method A.

Those in column G were heated on steam bath alone, otherwise like A. The steam used for the heating came from the boiler supplying heat for the building at a presure of 5 to 10 pounds.

The single determination in H was made upon the water bath; in other respects like A

From former observations I thought the amount of material used had some influence on the per cent. of fiber found, and the same quantity, two grams, were taken in all my trials except column I, where three grams were taken and treated as in A.

The fat had not been extracted from the material used in these trials for comparison, but to determine what influence this may have, the fat was extracted from one set before determining the fiber, and the results form column J. In other respects the same as A.

The determinations for column K were by method B, except that B was filtered through an asbestos filter and K through filter paper.

Column L is column K minus the ash.

In determining the the fiber of hay by method A, I made two sets at different times, and the last set gave lower results than was obtained the first time. I think the difference is due mainly to the heat being greater in the last case. The pressure and quality of the gas in this laboratory is quite variable. The gas is generated from gasoline and the pressure and quality gradually varies with the time from adding a fresh supply. The first set in A table II were made while the pressure was low, and the second set was made two days after putting in gasoline and with a high pressure. While the probable error for the six duplicates in each set is very nearly the same—0. 15 and 0 17—the difference between the two sets is 0 68 being less for the last at time of greatest heat.

In each set of determinations I have given the figures in full so that any one who may desire to, can compare throughout the results. The probable error has also been given, although the number of duplicate determinations are too few to afford much value in this direction.

TABLE I.

Wheat Bran.

	A	B	I	D	F	H	G
	14.43	14.76	15.02	14.62	17.81	26.20	24.41
	14.70	13.60	14.70	15.30	15.70	.....	25.04
	14.72	13.68	14.38	14.61	16.09	.....	24.09
	13.98	13.70	....	14.91	16.40	.....	24.80
	14.29	13.99	.....	13.79	18.24	.....	27.44
	14.31	13.24	.....	15.19	.....	.....	.....
Average	14.40	13.82	14.70	44.78	16.84	26.20	24.58
Probable error	.19	.35	.22	.23	·82	...	.26

TABLE II.

Hay.

	A	B	C	J	K	L	A
	37.14	36.19	35.51	36.07	34.72	34.41	36.18
	36.93	36.23	35.14	36.35	34.98	34.54	36.08
	36.50	36.78	36.22	36.57	33.34	32.97	36.54
	36.94	37.21	36.27	36.66	34.09	33.79	36.30
	36.99	36.09	35.80	36.61	35.10	34.67	35.87
	37.05	37.07	.....	.....	.....	...	36.50
Average	36.92	36.59	35.78	36.45	34.44	34.97	36.24
Probable error	.15	.49	.32	.16	.49	.45	.17

TABLE III.

Hay.

A	34.27
E	35.50

I may add that I do not consider the trial E to be quite satisfactory, as but two determinations were made, and those with some difficulty. The method is too cumbersome for satisfactory work.

For comparison, the averages for each trial are given in tabular form.

	Wheat bran. Table I.	Hay. Table II.	Hay. Table III.
A	14.40	36.92	34.27
B	13.82	36.59	
C	..	35.78	
D	14.73	....	
E	....	....	35.50
F	16.84	....	
G	24.58	...	
H	26.20	....	
I	14.70	...	
J	....	36.45	
K	....	34.44	
L	....	34.07	

In table II, B and K were treated the same except that B was filtered through an abes tos filter and K through filter paper. The abestos filter returned with the residue in boiling with the alkali prevents so thorough an agitation of the substance as in K, where nothing but the hay was returned, besides it is necessary to maintain a lower heat for B since the tendency to bump is considerably greater than in K. The faster the ebulition, even though the evaporated water be often returned, the more thorough is the agitation of the substance, and the more completely seem to be the solution of the material.

The difference in the amount of fiber found before and after extracting fat is not large in the case of hay, but with substances rich in oil, as linseed and cottonseed meal, the difference would be considerable, as has been shown by Dr. Johnson*. In my regular analyses the fat is always extracted from the substance before determining the crude fiber.

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*How Crops Grow, p. 392.

Reading of the air thermometers.

1886.	January.			February.			March.			April.			May.			June.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	34.	34.	31.	12.5	17.	15.	—.7	5.	6.	39.	41.2	44.5	54.6	61.2	58.	53.	72.	69.
2	26.	34.2	32.5	17.	18.5	12	7.7	12.	14.	32.	33.5	32.	52.7	69.5	65.5	62.	74.	77.2
3	36.	39.	41.	6.	6.2	1.5	18.	21.5	22.	27.	31.	28.	59.	70.5	66.	51.	58.7	58.
4	49.	50.	51.	-5.	—.5	-2.7	21.	23.7	27.	26.	32.5	30.5	55.2	69.7	78.2	53.	65.	64.7
5	37.5	34.	33.	-5.	1.	2.	25.7	30.	27.2	29.7	40.5	35.5	58.	60.	50.5	55.	72.5	73.
6	17.	9.5	6.2	9.5	14.	18.	22.	24.5	23.	36.5	40.	38.	49.2	59.5	50.	62.5	73.	75
7	4.	6.	7.	23.	28.	27.	21.2	34.5	34.	28.	32.7	29.5	51.2	57.	49.	64.	80.2	73.2
8	6.5	10.2	4.2	24.	44.7	42.	30.	39.	33.	29.7	35.5	38.	44.5	51.5	55.5	56.5	69.5	65.
9	8.	5.7	5.	33.	44.2	40.7	28.	22.	11.5	34.	53.2	52.7	48.	60.5	56.	56.	75.	67.2
10	6.	6.5	4.	32.	46.	41.2	12.7	27.5	25.2	40.	55.5	41.	49.	48.	53.	62.2	75.	69.
11	4.	7.2	6.	37.	41.	40.5	24.5	38.	37.	32.	44.7	51.	47.	56.2	56.7	60.	72.	66.2
12	-15.	-1.7	1.	39.	43.7	42.5	34.2	39.	36.2	41.	53.7	53	48.	70.2	64.	58.	72.2	68.5
13	-14.	8.2	5.5	40.	45.5	39.	31.7	29.	25.5	50.5	60.7	51.7	52.	59.	60.5	67.2	83.5	79.7
14	—1.	14.7	14.2	38.	38.5	42.5	30.	33.	32.	45.7	50.7	59.	54.5	65.2	67.	64.2	75.	77.
15	11.	25.	23.	32.	32.5	29.	30.	48.5	36.5	45.5	69.	70.	59.	61.5	57.	63.5	79.2	81.
16	28.	32.5	32.	21.	18.5	15.	31.	31.5	33.	54.	65.	65.2	49.	45.	48.5	68.5	68.2	75.
17	29.	26.2	22.5	14.2	23.	31.5	30.5	34.	34.	48.	62.	66.	45.	55.2	55.	59.7	78.	75.2
18	10.5	21.	15.	24.	33.	33.5	31.	40.	41.	52.	69.5	68.	45.5	63.2	59.7	53.7	59.5	61.2
19	26.	31.	29.	35.2	41.	38.	38.	39.2	41.2	50.	64.	65.	53.	69.7	69.2	55.5	65.1	63.
20	21.5	25.	25.	12.	9.	8.	39.5	46.	48.	49.5	69.5	65.2	63.5	70.	63.	57.	71.2	75.
21	30.	35.5	26.	10.2	18.	22.5	40.2	52.	42.5	52.	71.	65.5	52.5	63.5	62.	61.5	74.	75.7
22	13.7	23.	30.	8.2	25.	29.	33.7	34.7	31.7	53.7	75.	72.	65.	74.	74.	63.2	74.7	61.5
23	7.	7.5	5.	32.5	30.7	19.5	25.2	23.	23.7	56.	78.	73.	60.5	71.5	64.	56.	62.2	62.5
24	1.	5.	2.	9.	18.5	29.	23.5	33.7	36.7	45.	41.2	43.	58.	71.5	60.5	62.	70.	70.
25	16.	27.	31.	33.	33.2	38.2	39.2	60.2	48.7	43.5	54.5	50.5	48.	53.	47.7	54.5	71.7	71.7
26	33.	31.	30.	10.5	5.	7.7	38.	45.	45.	48.	58.7	61.7	41.6	50.5	55.	62.2	68.5	67.7
27	30.	34.5	35.2	3.	5.7	6.	27.	32.5	29.5	54.	54.2	58.7	46.	50.	51.	60.7	71.	68.7
28	30.5	30.5	31.	1.5	7.	9.	27.	37.	32.5	50.2	61.	58.2	53.5	63.	61.2	59.	71.2	68.7
29	26.7	28.	29.5	....	....	....	37.	42.	38.	45.5	60.	53.	52.	75.5	73.	61.2	77.	74.5
30	25.	28.5	21.2	....	....	....	38.7	43.5	49.	47.	58.2	56.5	65.2	70.	62.2	62.	72.7	67.7
31	19.	24.5	20.	....	....	....	51.5	61.5	59.5	....	....	....	56.7	66.	63.7	....	....	....

1886.	July.			August.			September.			October.			November.			December.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 P. M.	12 M.	6 P. M.	7 P. M.	12 M.	6 P. M.	7 P. M.	12 M.	6 P. M.
1	57.5	76.	73.5	67.5	81.7	71.2	54.	58.5	57.2	42.5	45.	42.2	46.	60.5	55.5	21.2	31.	32.2
2	62.	77.5	76.2	64.	67.5	62.	48.5	67.	68.	42.5	44.	44.2	43.5	61.	57.5	13.5	17.	15.5
3	66.7	82.	76.7	53.2	61.7	61.5	50.5	73.	72.	36.5	58.	54.5	50.5	64.	55.7	14.	18.	15.2
4	65.	84.2	80.	58.	67.2	67.	58.	69.2	70.5	44.	64.7	54.5	41.	49.	40.7	11.	10.5	3.7
5	65.	87.7	83.9	58.	65.5	63.	69.2	72.2	72.2	51.	56.	52.	40.	52.	52.5	6.	7.7	.5
6	70.	90.2	86.	55.2	70.5	69.5	61.	77.	77.7	47.	59.2	51.5	36.	36.2	32.2	13.	19.2	16.2
7	78.	90	82.5	61.7	74.5	70.2	60.	81.	80.5	40.	57.7	59.7	27.5	32.7	30.	16.7	20.7	20.
8	64.2	72.5	70.5	61.	79.7	77.	64.7	83.	81.	48.	70.	65.	27.5	30.7	31.2	28.7	33.	33.
9	61.5	74.	76.5	65.2	85.	81.	64.	74.7	68.	50.2	74.5	66.	34.5	47.	41.	30.	37.2	29.2
10	65.5	75.7	77.2	68.2	83.2	83.5	67.5	86.	70.5	51.	72.5	66.	33.7	43.7	43.5	26.	40.2	36.
11	64.7	67.5	66.2	71.2	80.	80.5	59.5	68.5	63.5	52.2	72.2	64.5	43.	44.	39.5	39.	41.2	38.
12	58.7	71.	71.	64.5	72.7	70.7	60.	59.	55.	53.7	69.	64.5	31.7	32.2	28.	33.	41.2	35.5
13	59.7	78.	71.7	61.2	82.	74.	49.5	58.	56.5	52.	57.6	60.2	27.	26.2	24.	38.	38.	39.
14	61.2	65.	67.5	68.	73.	68.5	53.5	63.7	64.	61.5	65.2	63.5	28.	35.	37.	27.2	29.7	31.
15	63.5	74.5	71.7	58.	69.2	64.	49.7	68.5	67.7	55.5	49.2	44.	33.	40.7	35.5	19.	12.7	9.2
16	64.	72.	67.	58.5	70.	67.7	60.	69.	72.2	33.	37.7	33.7	21.	32.5	27.2	5.	15.7	14.
17	63.5	76.2	71.5	57.	61.	60.5	70.	79.	61.5	30.7	35.7	41.5	36.	39.	45.	12.5	20.5	22.5
18	61.2	63.5	62.7	55.	69.5	65.	52.7	64.	59.7	43.2	45.2	44.5	46.5	44.	34.5	30.	35.	33.2
19	57.7	63.5	65.5	57.	71.	69.5	59.2	67.5	70.5	37.2	53.7	53.7	26.5	28.5	28.7	30.	29.5	28.
20	62.	72.2	69.5	59.	76.	73.	48.7	54.5	52.7	49.7	67.2	59.7	29.	42.5	39.7	23.7	28.7	20.7
21	62.7	76.	72.	62.2	75.8	72.5	45.2	54.2	49.	48.5	51.2	44.2	33.	41.9	36.	26.7	34.	33.7
22	55.5	65.7	66.5	62.7	75.5	75.2	42.5	58.5	57.	38.7	63.6	60.	30.5	40.5	39.	32.	33.7	28.2
23	60.	68.	68.	64.2	74.2	75.	54.	61.2	59.	42.2	50.5	41.2	43.5	48.	56.7	19.	29.5	31.5
24	60.	76.	74.	65.7	70.	67.	50.2	67.2	65.2	42.5	56.	55.2	36.	31.2	31.	35.	41.7	36.
25	66.2	81.	79.5	64.5	73.	70.2	60.2	74.5	77.	52.	59.	49.	31.7	31.7	30.	17.7	16.2	7.2
26	69.	74.	66.	58.	77.5	77.	67.	68.	70.	35.5	37.2	37.5	27.	30.5	27.	18.	22.	26.
27	67.7	77.5	75.	63.5	83.5	81.2	57.	66.	68.	39.5	44.7	44.	19.2	29.5	30.	22.	20.2	17.
28	67.	80.2	75.7	63.7	83.	79.	66.	67.	56.7	45.	48.7	46.5	29.	36.7	34.7	12.2	13.7	11.7
29	68.5	76	82.2	67.	85.	81.5	47.5	58.	56.	43.5	47.5	47.	35.5	42.5	35.5	14.	13.	6.7
30	66.5	78.2	73.2	71.7	79.	68.	46.	63.2	59.	47.7	47.7	47.7	23.7	25.7	26.2	2.	12.	6.5
31	63.2	76.5	75.5	63.2	67.2	63.	....	....	....	46.7	56.2	49.5	....	....	...	15.	21.	24.5

Readings of the maxima and minima thermometers, 7 A. M.

1886.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1	40.	33.	26.	11.5	10.5	—2.	65.	38.	61.2	40.	68.5	42.2	74.7	45.2	79.	60.5	68.5	52.7	66.	41.2	58.2	44.7	27.7	19.2
2	35.	24.5	18.7	10.	8.5	—2.5	46.5	31.2	65.5	46.7	77	53.	80.5	53.2	83	62.	63.5	42.5	49.	38.	63.7	42.5	33.2	12.
3	39.5	24.	24.7	4.	17.5	5.5	36.7	24.2	70.2	52.5	81.2	50.	80.	52.7	70	50.	71.7	47.	51.	33.	68.2	43.	20.	11.7
4	49.	35.	11.	—6.	24.5	18.	33.	22.	72.	48.7	60.7	42.7	84.	53.2	66.5	52.	77.7	51.5	60.5	36.	64.5	40.7	19.5	10.
5	52.5	36.	0.	—8.5	27.5	20.5	33.	25.	71.	55.	68.5	44.7	87.	52.7	70.7	53.	75.5	57.7	68.2	44.	50.	32.2	10.5	1.
6	39.	16.5	9.5	6.2	31.	22.5	44.	29.	61.2	41.	75.2	51.7	89.5	61.	67.2	47.7	76.2	57.	58.2	42.7	60.	35.5	13.	—6.
7	17.5	2.5	23.	8.	27.	18.7	41.	26.2	64.2	41.	77.2	57.5	95.	69.7	74.	53.5	86.2	58.7	63.7	38.	37.2	26.5	21.	11.
8	6.	2.	29.	20.	39.	20.2	34.	27.	63.	43.	81.5	48.	90.	59.	76	54.2	85.	61.	65.	39.2	34.	26.	29.	15.
9	11.	1.	50.	23.7	40.	27.2	39.2	29.	57.7	42.7	71.2	47.5	75.	52.	82.	58.7	85.2	62.	74.	47.5	37.2	26.	33.7	27.
10	9.5	2.5	46.7	29.5	29.	9.	58.	34.5	62.5	42.7	78.2	51.	80.2	61.2	86.5	63.	80.	60.7	76.7	48.	49.5	32.5	38.	23.5
11	8.	0.	48.5	31.5	29.7	11.5	57.2	30.	57.5	46.	77.5	56.	80.	59.7	87.5	68.7	89.5	57.	76.5	30.	46.5	33.	46.	25.
12	5.	—17.2	42.	33.	42.2	24.	54.	31.5	62.7	41.2	73.	45.5	71.5	47.	87.	61.5	72.2	54.	76.2	52.	44.2	30.5	42	33.
13	4.	—18.7	49.	38.	40.7	31.2	62.7	39.5	72.7	46.5	74.	58.	76.	54.	75.5	54.5	62.5	47.	75.5	51.5	32.2	23.7	42.7	32.
14	12.7	—7.5	48.	37.	32.	23.2	61.2	45.	62.5	49.2	86.2	63.	80.5	59.2	80.	61.	62.	49.	63.5	51.7	29.	23.5	43.	26.5
15	19.	—1.	43.	31.5	36.2	27.7	60.	39.7	69.	52.2	82.	61.	68.5	60.7	74.	50.7	70.2	46.7	68.2	42.	39.	26.7	32.5	18.
16	30.	10.	34.	20.5	58.	28.5	74.	45.5	67.	46.7	84.2	62.5	75.5	62.2	71.	52.2	73.2	48.5	56.8	32.2	41.7	20.	20.5	2.5
17	33.7	27.	22.	11.5	35.	26.	74.	44.2	54.5	37.2	77.2	65.	73.	51.	71.7	56.5	78.7	58.7	40.5	27.5	38.5	20.	20.	3.7
18	34.	8.7	33.7	12.7	39.	28.	70.	45.	58.7	37.2	79.7	51.5	79.	60	62.	50.	80.5	49.	45.5	30.2	57.	35.	30.	12.
19	28.	10.	39.	22.7	44.	30.	71.7	46.	66.7	45.5	65.	47.1	70.5	51.7	71.	49.5	68.	47.2	47.5	32.2	47.	24.7	39.	29.
20	36.	20.7	42.7	11.2	43.7	37	68.7	43.5	72.7	52.	69.	46.2	68	57.2	74	52.5	75.5	46.5	60.2	36.7	32	25.	31.	22.2
21	31.2	19.	12.5	6.5	55.	39.	71.2	45.5	71.	44.	76.2	52.7	74.2	56.	77.5	58.7	57.7	43.7	70.7	48.2	46.	28.	30.2	17.7
22	37.7	10.	24.7	9.	52.7	32.7	73.7	47.5	67.7	51.7	81.2	58.9	77.7	55.	78.5	59.7	56.7	40.	54.2	37.7	44.7	29.7	40.	25.7
23	33.6	6.	36.	17.	37.5	24.5	78.	50.	79.5	52.7	75.	55.	70.7	48.7	81.	62	60.7	42.	62.2	38.2	44.	29.	35.2	18.
24	9.	—5.	33.	8.2	27.2	21.	80.5	44.5	73.	49.	65.	55.	73.	52.7	80.	63.5	67.	47.2	52.2	33.2	58.7	35.5	36.	18.2
25	16.	—2.5	33.5	6,	40.5	22.2	45.2	38.7	72.5	45.	75.2	60.7	78.	60.	70.7	61.2	72.2	49.5	58.	42.	36.5	29.	46.	17.7
26	34.9	9.	40.2	9.	62.5	36.	59.	43.	55.	39.3	77.2	60.	83.	66.	74.7	54.5	85.	59.7	66.	35.	33.	24.2	22.	4.
27	33.5	26.5	13.5	—11.	48.2	24.7	64.2	47.7	58.5	40.5	71.2	57.7	75.7	64.7	82.	57.5	72.5	51.	29.7	34.5	33.	17.2	20.	16.5
28	36.7	29.	8.7	0.	35.	24.	63.7	45.	53.7	44.	71.7	50.7	79.5	59.7	85.5	60.	70.5	56.5	45.7	38.7	32.5	17.	22.2	9.5
29	31.5	23.5			39.	25.5	63.	38.	65.7	45.	72.5	49.	84.5	63.5	86.7	63.	72.	44.7	49.2	43.	37.7	27.	17.	10.
30	30.	24.			42.5	33.5	62.5	43.7	77.2	51.5	79.7	52.5	85.	64.	91.5	66.7	62.7	42.2	49.	43.	43.7	23.	15	2.5
31	30.	16			53.	37.5			70.	47.			81.	61.	83.	62.7			49.7	46.2			18.2	.5

Reading of soil thermometers.

April, 1886.	1 inch.			2 inches.			3 iuches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	37.2	42.2	40.5	39	42	41.5	40	43	41.7	43	42.5	42.2	44	42.5	42.2	42.5	42.2	41.7
2	33	38	35.5	34.5	38.2	38	35	38	38.2	37.5	38.2	39.5	39	38.3	39.5	41	40.5	40
3	32	43	37.2	32.7	42	39.7	33.2	40.5	40	35	36.5	39.2	36.2	36.2	39	39	39	38.7
4	31.2	37.2	36	32.2	35	37	33	34.7	37	34.7	34.7	37.5	36	35.5	37	38.5	38.2	38
5	32.2	48.2	42.2	33	46	44.2	33.5	44.5	44.5	35	38	43.5	35.5	36.7	41.2	37.7	37.7	38.7
6	36	38.5	39	36.5	38	39.2	37	38	39	37.7	38	38	38.2	38	38.5	39	38.7	38.7
7	32.2	40.5	36	34	39	37.5	34.2	38	37.7	35.5	37	38.5	36.5	36.5	38	38.5	38.2	38
8	31.7	45.2	43.5	33.5	45.7	45.7	34	44	45	35	37.7	44	35.7	36.7	41.2	37.7	37.7	38.2
9	31.5	51.2	52.5	34	51	53	34.5	48.5	52	36.2	41.5	48.7	37.	38.5	44.2	38.7	38.5	39.2
10	40.5	58	48	40.7	54.7	50	41	52.2	50	41.5	46.2	49.5	41.5	43	46.7	40.5	40.7	41.5
11	36.5	48	49	37.2	45.5	48.5	38	44.5	48.2	39.5	42.2	47	40.5	41	44.5	42	41.5	41.5
12	40.2	50.7	52	40.5	48	51.7	41	47	51.2	41.7	43.7	49	42	42.5	46	42	42	42.2
13	48.7	58.5	53.5	48	55	54	48	53.5	54	47	49.5	52.5	46.	47	49.5	43.2	43.5	44.5
14	48	54	57.5	48	52.5	58.5	48	52	58	48	49.5	55.2	47.5	47.7	51.5	45	45.2	45,5
15	46.7	66.2	64.4	45.7	63.7	64.7	46	61	64.2	47	63.5	61	47.2	49.5	55.5	46.2	46.2	47.2
16	52.2	62.7	63.5	51	61.7	64	51	60	63.7	51.5	55	60.7	51.2	52	56.2	48.5	48.5	49
17	48	61.7	64.2	47.5	60.5	64.7	48	59	64	49.2	53.5	60.7	50	50.7	56	49	48.5	49
18	51.7	69.5	69.2	50	67.5	69.5	50.2	63.7	68.7	51	56.5	64.5	51.2	52.5	59	49.7	49.5	50
18	52.5	71.5	65.2	51.7	67	65	52	64.2	64	53	58.5	61	53	54.5	57.5	51	51	51.2
20	52.7	70.7	70.7	51.5	69	71.5	51.5	65.5	70.2	52.2	58.5	66.5	52.2	54.5	61	51.5	51.2	52
21	54	74	70.5	53.5	71.7	71.5	53.5	68	70.7	54.5	60.5	67.5	54.5	56.2	62.2	53	52.5	53.2
22	55	74.2	74.7	54.2	71.7	75	54.5	68	73.7	55.5	61	69.5	55.5	57	63.5	54	53.5	54.2
23	56	76.5	73	56	73.7	74	56.2	70	73	57	63	69.5	57.2	59	64.2	55	54.7	55.2
24	54.5	53	50.7	57	54	52	57.5	54.5	52.5	59.2	56	54	59	56.5	54.4	56	55	54.2
25	48.2	60.5	56.5	48.5	59	58	48.5	57.5	58.2	49.7	53.5	58	50.7	52	55.5	52.5	52	52.2
56	50	61	61	50.2	58.2	61.5	50.5	57.2	61	51.5	54	58.7	52	52.5	55.7	52	52	52
27	53.5	56	54.5	53.5	55.9	56.5	53.5	54.5	56.5	54	53.5	56	53.7	53	54.2	52.5	52.5	52.2
18	47.2	65.5	61	48	63.2	62	47.2	60.5	62	48.5	54.7	60.2	49.7	52	57	51.5	51	51.7
29	49.7	68.2	60	49	63.5	61.2	48	61	61.2	49.5	55.2	60	50.7	52.5	57	52.2	51.7	52
03	50	63.7	59.5	50	61	60.7	49.5	59.5	61	51	55	59.7	52	53	57	52.5	52	52.2

Reading of Soil Thermometer.

May.	1 inch.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	50.5	68.2	64.5	49.5	64.7	66.	48.5	62.2	65.5	49.7	66.	63.2	51.	63.	59.	52.2	62.	52.5
2	53.	73.	70.2	51.7	68.5	71.2	51.7	65.5	70.5	52.7	59.	67.	53.5	55.5	62.	53.2	53.	54.
3	57.	74.2	68 7	55.2	70.	70.	55.2	67.5	69.5	56.	61.2	66.7	56.	57.7	62.5	55.	54.5	55.2
4	56.2	69.2	59	55.7	65.5	60.5	56.	64.	61	56.7	60.5	61.2	57.	58.	59.7	55.5	55.2	55.2
5	58.	63.	56.	57	61.7	58.7	57.	61.	59.	57.	59.	60.	56.5	57.	58.5	55.	55.	55.
6	51.5	68.	66.	50.5	64.5	67.5	50.5	62.5	67.	51.5	67.7	64.5	53.	55.	60.3	54.5	54.	54.5
7	54.	71.5	61	52.	67.	63.	52.	64.7	63.	53.	59.2	62.5	54.	56.	60.	55.	54.5	55.
8	50.	59.7	61.5	51.	57.	62.5	51.5	56.	62.	53.2	54.2	60.	54.	53.7	57.5	55.	54.2	54.2
9	51.2	71.7	65.5	49.2	66.2	66.3	49.2	63.5	65.7	50.5	57.5	63.5	52.	54.5	59.5	54.	53.5	54.
10	52.	50.2	51.5	52.	51.2	51.7	52.	51.5	52.	53.5	53.	52.7	54.5	53.5	53.	54.7	54.	53.5
11	49.2	62.2	64.2	50.	59 5	66	50.	58.2	65.2	51.2	54.5	63.	52.	52.7	58.7	53.	52.7	53.2
12	52.5	73.	71.	51.	67.5	72.5	51.	65.5	71.7	52.2	59.5	68.5	53.2	55.7	63.2	54.	54.	55 .
13	55.	59.5	61.2	55.	58.5	61.	55.5	58.2	61.	56.5	57.5	59.5	57.2	56.7	58.	56.2	56.	55.5
14	55.	65.	63.2	54.	62.2	63.2	54.	61 5	63	54.5	68.2	61.7	55.	56.2	59.5	55.5	55.	55.5
15	57.2	60.	59.	56.7	59.	56.7	57.	58.7	60.	57.2	57.7	59.2	57.	57.	58.	56.	55.5	55.5
16	52.	52.5	52.5	52.	54.	54.5	52.	54.2	55.	53.5	55.	55.7	54.	54.5	55.	55.	54.5	54.5
17	47.	62.2	61.5	45.5	59.5	62.7	45.2	58.2	62.5	47.	53.7	60.5	49.	51.5	57.5	53.5	53.	53.5
18	50.	67.7	64.5	48.7	63.2	65.2	48.7	62.	65.	50.	56.5	65.2	51.5	54.	59.	53.7	53.5	54.
19	54.	72.2	72.	52.5	68.7	72.5	52.7	66.7	72.	53.5	61.	68.5	54.2	57.	63.5	54.7	54.7	55.5
20	60.5	74.5	70.	58.5	71.5	72	58.5	69.5	72.	58.2	64.2	69.5	58.5	60.5	65.2	57.	56.7	57.5
21	58.	73.7	67.7	56	70.	69.5	55.5	68.7	69.7	56.5	63.	68.5	57.5	59.5	64.5	58.	57.5	58.
22	60.5	78.5	75.5	60.	73.7	76.	60.	72.	75.5	60.	65.5	72.	59.7	61.7	67.2	58.2	58.2	59.
23	62 5	79.7	71.8	60.7	75.2	73.5	60.5	73.8	73.5	61.	67.5	72.	61.9	63.7	68.	59.7	59.5	60.5
24	60.5	77.5	68.5	60.8	73.	70.5	59.8	71.5	70.5	59.	65.7	69.2	59.2	62.5	66.	61.	60.	60.
25	56.5	63.2	55.7	56.2	62.	59.6	56.2	61.2	60.	58.	59.2	61.3	59.2	58.5	61.	60.	59.	59.
26	47.1	55.7	57.	49.	54.7	58.	49.5	54.5	58.	52.	53.7	57.2	54.	53.7	56.2	57.2	56.5	56.2
27	48.	50.5	53.2	49.	50.5	53.5	49.2	50.5	53.5	51.	51.	53.	52.5	52.	52.7	55.5	54.7	54.2
28	52.	67.5	63.	49.5	64.5	64.5	49.	62.5	64.2	49.	67.2	62.5	50.5	54.	59.2	53.7	53.5	54.5
29	52.5	72.	70.7	51.5	67.5	70.7	51.5	66.	70.5	52.7	60.	67.	54.	56.5	62.7	55.2	55.2	56.
30	63.	77.5	71.	61.	73.2	72.8	60.7	72.	73.	60.	71.	70.7	59.5	62.	66.7	57.5	57.7	58.7
31	60.2	76.2	71.2	58.5	72.7	74.	58.2	71.5	74.	58.7	65.2	72.	69.5	61.7	67.5	59.	58.7	59.5

Readinf of Soil Thermometers.

June.	1 inch.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 AM.	12 M.	6 P. M.
1	57.5	74.7	72.5	56.2	71.5	74.2	56.	70.5	74.5	57.2	64.5	71.7	59.	61.2	67.5	59.7	59.	60.
2	63.5	74.2	73.2	63.	71.5	72.5	63.	70.7	72.2	63.	67.	69.7	62.5	64.	66.5	60.5	60.2	60.5
3	55.5	66.2	60.2	57.2	65.2	63.	58.	64.2	63.6	60.5	62.2	63.7	61.5	61.2	62.5	61.	60.2	60.2
4	55.5	73.	69.	53.2	70.2	71.7	52.7	68.	72.	54.	61.7	69.5	55.7	58.7	65.5	59.	58.2	59.
5	57.7	75.5	73	56.	72.	73.2	56.	70.2	73.	57.2	64.5	70.	58.5	61.2	66.5	59.5	59.	60.
6	63.5	80.	76.	61.	76.2	77.2	60.5	74.2	77.2	60.5	68.	74.2	61.	63.7	69.5	60.2	60.	61.
7	63.2	80.	76.2	62.5	77.	77.2	63.	75.	77.2	63.2	69.5	74.5	63.2	65.7	70.5	61.5	61.5	62.2
8	59.	79.5	73.5	58.5	76.	76.2	58.5	74.	76.2	60.	67.5	74.	61.5	64.	69.7	62.	61.5	62.
9	60.	80.	72.5	59.	74.5	73 5	59.	73.7	73.2	60.2	67.	71.5	61.5	64.	68.2	62.	61.5	62.
10	61.5	82.	75.2	60.5	78.	77.	61.	76.	77.	61.5	69.	74.2	62.2	65.	70.2	62.	61.5	62.2
11	63.	83.	75.7	63.2	80.2	78.5	63.2	78.	79.	63.5	70.7	76.2	64.	66.5	72.	62.5	62.5	63 2
12	61.	82.2	73.5	60.5	72.2	74.2	60.2	75.5	74.	61.5	68.5	72.	63.	65.2	69.	63.2	62.7	63.
13	66.5	87.5	82.7	65.	83.2	83.7	65.	81.	83.2	65.	72.5	79.5	64.7	68.	74.7	63.	63.	64.
14	68.2	83.	81.	68.7	79.5	81.5	69.	77.7	81.2	69.2	72.2	78.2	68.7	79.2	74.2	65.	65.	65.5
15	67.2	84.5	82.2	67.	80.	82.5	66.7	78.	82.	67.5	72.5	78.5	67.5	79.2	74.5	65.5	65.	65.7
16	69.5	72.2	74.5	68.2	73.	74.7	68.2	72.5	74.5	68.5	71.	72.7	68.2	69.	70.2	66.	65.5	65.5
17	68.7	78.	73.5	67.7	76.	74 5	67.7	74.5	74.5	67.5	71.2	73.5	67.	69.	71.	65.	65.	65.5
18	58.5	71.7	68.	59.7	71.5	71.2	60.2	70.2	72.	62.	66.2	71.2	63.5	64.5	69.	64.7	64.	64.2
19	56.7	71.7	70.5	57.	69.5	73.2	57.5	67.7	73.2	59.	64.	71.	61.	62.7	68.	63.5	63.	63.
20	59.7	79.5	76.	58.2	75.	76.7	57.7	73.	76.2	59.	66.5	73.2	60.7	63.7	69.7	62.5	62.2	63.2
21	62.2	75.5	74.5	61.2	70.5	75.	61.3	69.7	74.7	62.5	66.	72.	63.1	64.2	69.7	63.2	63.	63.2
22	63.7	79.5	66.7	63.2	74.2	69.	63.2	73.	69.2	64.2	68.	69.7	64.	65.7	67.7	63.5	63.2	63.2
23	58.5	66.7	65.	59.5	64.7	65.7	59.7	64.2	65.5	61.2	62.7	65.2	62.	62.	64.	62.2	62.2	62.
24	63.5	73.	69.2	63.	70.	69.7	62.7	68.7	69.5	62.5	65.7	68.5	62.5	64.	66.2	62.	62.	62.2
25	65.2	74.7	72.	64.7	72.5	73.2	64.7	71.	73.	64.7	68.7	71.5	64.2	66.2	69.	62.7	63.	63.5
26	63.5	69.7	68.7	63 5	68.2	70.	63.5	67.7	69.5	64.2	66.2	68.7	64.7	65.	67.	64.	63.5	63.5
27	61.2	77.2	73.1	61.	75.2	75.	61.2	68.2	74.5	62.5	67.7	72.5	63.	65.	69.7	63.2	63.2	64.
28	62.5	79.7	74.5	61.2	76.7	77.5	60.7	74.7	77.	62.	68.2	74.5	63.5	65.5	71.2	64.2	63.7	64.5
29	63.	81.5	78.2	61.5	78.2	79.7	61.2	76.	78.7	62.7	69.2	75.5	64.	66.5	72.	64.7	64.5	65.2
30	65.5	82.7	76.5	64.5	79.5	79.5	63.7	77.5	79.	65.	70.7	76.5	65.7	67.7	73.2	65.5	65.2	65.7

Reading of soil thermometers.

July, 1886.	1 inch.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	6 A. M.	12 M.	7 P. M.	7 A. M.	12 M.	6 P. M.
1	61.5	82.2	78.	61.2	77.5	79.7	61.2	75.5	79.2	63.2	69.	76.	65.	66.5	73.	66.	65.2	65.7
3	64.5	83.7	79.7	64.2	79.	80.7	64.	77.	80.5	65.5	71.2	77.	66.5	68.2	73.5	66.2	66.	66.2
3	67.2	87.7	81.7	65.2	83.	83.2	65.	80.2	83.	65.5	73.2	80.	66.5	69.2	75.5	66.5	66.2	67.
4	67.7	88.7	84.	66.	83.5	85.	65.7	81.	84.7	67.	73.7	81.2	68.	70.2	76.7	67.5	67.	67.7
5 —	68.	90.	85.5	66.5	84.7	86.4	66.2	82.	81.3	67.5	74.7	82.5	68.5	71.	78.9	68.	67.7	68.5
6	71.2	90.5	87.	69.7	84.5	87.	69.5	83.	86.5	70.5	76.5	83.	70.5	73.	78.5	69.	68.7	69.2
7	75.	92.	85.5	74.	86.2	86.2	74.2	84.5	86.	74.	78.5	84.	73.2	74.7	79.	70.	69.7	70.2
8	71.2	86.5	80.	70.5	84.	83.5	70.	82.2	83.5	71.	76.5	81.5	71.7	73.2	78.2	70.	69.5	70.
9	66.7	81.	80.	66.7	78.	80.	66.7	77.	80.	68.2	72.7	77.5	69.2	70.5	74.5	69.5	68.7	69.
10	69.7	82.	77.7	68.5	80.	79.	68.	79.	79.	68.7	74.2	77.5	69.2	71.2	74.7	68.5	68.2	69.
11	67.	76.5	75.2	66.	73.7	78.5	65.7	73.	78.5	67.	69.2	76.5	68.2	68.2	73.5	68.5	68.	68.
12	64.	82.5	78.	61.5	79.	80.	61.2	76.7	80.	63.	70.7	77.	65.2	68.	73.5	67.5	67.	67.2
13	64.5	87.5	72.5	63.5	76.7	73.5	64.	75.5	73.7	65.5	70.7	73.7	66.5	68.	72.	67.5	66.5	67.2
14	62.	65.5	66.2	63	65.5	66.2	63.2	65.2	66.2	65.2	65.7	66.2	66.	65.5	66.	67.	66.2	66.
15	64.7	77.	71.5	63.7	73.	72.	64.	71.7	71.7	64.5	67.5	70.7	64.7	65.7	68.7	65.2	65.2	65.5
16	65.5	73.7	68.5	65.5	71.5	69.7	65.5	70.2	69.7	66.	67.7	69.7	66.2	66.5	68.5	65.7	65.7	66.
17	64.	75.5	73.2	62.2	72.5	73.5	62.	71.5	73.5	63.	68.	72.2	64.	66.	70.	65.5	65.2	65.5
18	63.5	66.2	68,	63.5	66.2	69.7	63.5	66.	70.	65.	66.2	69.5	65.7	65.7	68.	66.	65.5	65.7
19	60.	68.7	67.5	60.	67.2	68.2	60.2	66.5	68.	62.	65.	67.5	63.2	64.2	66.2	65.2	64.7	64.7
20	61.2	75.2	72.5	61.	71.5	74.	61.2	70.5	74.	62.2	66.5	72.	63.2	64.7	69.2	64.5	64.5	65.
21	63.5	80.7	75.	62.5	76.7	76.	62.7	76.	75.7	63.5	70.2	74.	64.5	67	71.	65.2	65.2	66.
22	61.	74.2	74.5	62.5	72.	77.5	63.	72.5	78.2	65.	68.5	76.	66.	66.5	72.2	66.	65.7	66.2
23	61.	78.	76.	60.5	75.5	78.5	61.	74.5	78.5	62.5	69.5	75.7	64.5	66.7	72.2	66.5	66.	66.5
24	62.7	81.7	79.2	62.2	77.7	80.7	82.5	77.	81.	64.	72.2	78.2	65.5	63.	74.	66.5	66.2	67.
25	66.7	67.2	79.5	67.	70.	80.	67.2	72.5	80.	68.5	78.	77.9	68.5	78.2	74.5	67.5	83.	68.
26	69.5	74.5	69.5	69.2	73.5	71.7	69.5	73.5	71.7	70.2	71.2	73.2	70.	70.2	72.	68.2	68.2	68.
27	68.5	80.2	76.	67.7	77.2	78.	67.7	76.7	78.	68.	72.5	76.5	68.	70.	73.5	67.7	67.7	68.2
28	66.5	82.7	79.7	65.5	79.2	81.	65.5	78.2	81.2	66.5	73.	79.	67.5	70.	75.2	68.2	68.	68.5
29	68.5	74.5	80.5	67.5	72.	80.5	67.7	71.5	80.2	68.7	70.	76.7	69.5	69.5	73.5	69.	68.7	68.7
30	69.	82.5	79.	69.	79.3	80.5	69.	78.	81.	69.7	74.	79.	70.	71.2	75.7	69.	69.	69.5
31	66.	80.7	80.5	66.5	78.	82.5	67.	77.2	82.5	68.7	72.7	79.5	69.7	70.5	76.	69.7	69.2	69.7

Reading of the soil thermometers.

August.	1 inch.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P, M.	7 A, M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M	6 P. M.
1	69.	84.	73.2	67.7	80.5	74.	68·	79.7	74.2	69.	74.5	74.	69.7	71 5	73.	70.	69.5	69.5
2	67.5	76.5	72.	67.	73.7	74.7	67.2	73.5	75.2	68.5	71.	75.	69.2	69.7	73.	69.2	69.	69.
3	57.	70.	68.	58.	67.5	70.	59.	67.2	70.	62.	64.7	69.5	54.5	64.5	68.	68.	67.	67.
4	61.	75.2	74.5	59.2	71.7	75.5	59.7	70.7	75.	61.2	66.5	72.2	63.	65.	69.2	66.	65.5	66.
5	61.5	77.5	69.2	60.5	74.5	70.2	61.	73.	70.	62.5	68.5	69.5	64.2	66.	68.	66.	65.5	66.
6	59.2	78.7	77.	58.	73.5	78.5	58.5	72.	78.2	60.	67.	75.2	62.	64.5	71.5	65.2	65.	65.5
7	64.5	82.5	76.	63.2	78.	77.2	63.5	76.5	77.2	64 7	70.5	75.5	65.5	67.5	72.5	66.2	66.	66.5
8	64.	84.5	81.	63.7	79.5	82.2	64.	77.5	82.	65.7	71.5	79.	66.5	68.5	74.7	67.	66.7	67.5
9	66.2	85.	83.	66.	81.	84.	66.2	79.5	83.5	67.7	73.2	80.2	68.5	70.2	76.	68.	67.7	68.5
10	69.	85.5	83.	68.2	82.	83.5	68.7	80.2	83.	69.5	75.	79.7	70.	71.7	76.2	69.	68.7	69.2
11	71.5	86.2	81.5	71.5	83.2	82.7	71.5	81.7	82.5	72.	76.2	80.7	71.7	73.	77.5	69.7	69.5	70.
12	65.	77.5	74.5	65.5	75.7	77.5	66.2	74.7	77.5	68.5	71.5	76.	69.5	70.	73.5	69 5	69.	69.
13	62.	79.2	72.2	62.	76.	73.	62.5	75.2	73.	64.5	70.2	72.5	66.2	68.	71.	68.2	67.7	68.
14	68.	75.7	71.2	67.5	74.	74.	67.5	73.2	74.	68.5	70.	73.5	68.5	68.7	71.7	68.	68.	68.
15	61.	77.5	74.7	60.	75.5	78.	60.5	74.	77.7	62.2	68.5	75.7	64.5	66.5	72.2	67.2	66.7	67.
16	61.	71.5	67.	61.5	70.2	67.	62.	69.7	67.	64.	67.5	67 5	65.5	66.2	67.	67.	66.5	66.5
17	61.	65.7	63.7	62.5	65.5	64.5	62.	65.2	64.5	63.5	64.7	65.	64.5	64.5	65.	66.	65.5	65.5
18	58	72.5	68.5	57.	70.5	70.2	57.7	69.	70.	59.2	65.	69.5	61.2	63.2	67.5	64.7	64.2	64.5
19	57.7	75.5	73.7	57.2	74.2	76.	58.	72.	75.7	59.7	66.5	73.5	61.5	64.	70.	64.5	64.5	65.
20	60.	77.2	74.	60.	75.2	76.	60.5	74.2	76.	62.	68.	74.2	63.5	65.5	70.7	65.5	65.	65.5
21	63.	76.5	74.	63.5	76.	75.2	64.	75.7	76.	65.5	69.9	74.2	66.	67.5	71.5	66.	66.	66.2
22	63.5	75.7	76.2	63.7	74.7	77.7	64.5	74.5	77.7	65.5	69 5	75.5	66.2	67.2	72.	66.5	66.2	66.7
23	65.	74.	74 7	65.5	71.	75.	66.	70.7	75.	67.	68.2	72.7	67 2	67.5	70.2	66.7	66.5	66.5
24	67.	73.5	69.5	67.2	72.	70.2	67.2	71.5	70.	68.	69.	70.	68.	68.	69.	66.	66.7	66.7
25	66.	77.5	73.2	65.5	75.7	74.7	65.5	74.7	74.5	66.	70.2	73.2	66.5	67.7	70.7	66.5	66.5	66.7
26	60.5	77.	78.5	61.	77.7	80.5	61.5	76.5	80.	63.5	69.7	76.7	65.	67.	73.	66.5	66.5	67.
27	63 7	83.	81.5	64.	81.5	83.	64.5	80.	82.5	66.	72.2	79.	67.	69.	75.	67.5	67.2	68.
28	65.7	83.2	81.2	66.	81.7	83.	66.7	80.5	82.7	68.5	73.7	79.7	69.	70.5	75.7	68.2	68.2	68.7
29	67.7	83.5	82.	68.2	81.7	83.5	68.7	81.	83.5	70.	74.5	80.5	70.5	71.7	76.5	69.	69.	69.5
30	71.	81.2	70.2	71.	80.	72.5	71.2	80.	72.5	72.	75.5	74.5	71.7	73.	74.	70.	69.7	70.
3	66.2	71.5	68.	67.	71.	70.	67.2	70.5	70.	66.	69.5	70.7	69.5	69.	70.	69.2	68.7	68.5

Reading of Soil Thermometer.

September.	1 inch.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1																		
2	56.7	66.5	65.	58.	67.5	68.7	59.	67.	68.5	62.	64.5	68.7	64.	64.5	67.5	67.2	66.5	66.2
3	52.	70.2	71.7	52.7	70.5	74.5	54.	70.2	73.7	57.5	63.7	71.	60.5	62.2	68.	65.	64.5	64.7
4	55.2	73.2	72.5	56.	73.	75.	57.	72.5	74.5	60.	70.7	72.2	62.	63.2	69.	65.	64.2	65.
5	58.2	71.2	70.5	58.5	70.	62.2	59.5	70.	72.	61.7	65.7	70.2	63.2	64.2	68.	65.	64.7	65.
6	60.2	72.7	73.7	60.5	71.5	75.2	61.2	71.2	74.7	62.7	66.	72.5	63.7	64.5	69.2	64.7	64.5	65.
7	60.5	77.	76.5	60.7	76.2	78.2	61.5	75.7	77.7	63.2	68.7	74.7	64.	66.	71.2	65.	65.	65.5
8	60.2	78.2	78.2	60.5	77.	79.7	61.2	77.	79.5	62.7	75.	76.5	63.7	67.2	72.5	64.7	65.5	66.
9	64.5	80.7	79.2	65.	79.	80.7	65.5	79.	80.2	67.	72.	77.5	67.5	69.2	74.	67.	66.7	67.2
10	66.5	77.2	75.5	66.7	74.5	78.	67.	74.7	77.5	68.5	71.	75.7	68.5	69.2	73.	67.7	67.5	67.5
11	66.5	83.5	71.5	66.2	80.2	75.	66.7	80.	75.5	67.5	73.5	75.	68.	70.	73.5	67.5	67.5	67.7
12	61.	70.	70.	62.5	73.	74.	63.5	73.7	73.7	66.	69.	73.	67.2	67.5	71.	67.7	67.5	67.2
13	59.7	61.2	58.2	60.5	62.	59.5	61.	62.5	60.	63.	63.2	62.	64.5	64.	63.	66.5	65.7	65.
14	50.5	59.7	60.5	59.5	62.	63.5	52.7	62.7	63.2	56.	59.7	63.5	57.7	59.5	62.7	63.5	63.	62.7
15	55.5	62.	63.5	56.	62.5	65.2	56.5	62.5	65.	58.	61.2	64.5	59.	60.5	63.2	62.	62.	62.
16	52.	67.7	68.7	52.5	68.2	71.	53.5	68.5	70.7	56.5	62.2	68.7	58.5	60.5	65.7	62.	62.	62.
17	59.2	68.5	70.2	60.	66.5	70.5	60.7	66.	70.	61.7	63.	68.7	62.2	62.2	66.2	62.7	62.7	63.
18	66.	76.2	66.2	65.	76.5	68.7	65.	75.7	69.	65.2	70.5	70.	65.	67.2	68.7	64.	64.2	64.7
19	55.5	67.7	66.7	56.	71.7	70.5	57.	70.7	70.5	62.	65.2	69.7	62.2	63.5	67.2	64.2	64.	64.
20	58.	63.2	65.	58.	62.5	65.2	58.	62.2	65.	59.7	61.2	64.5	60.5	61.	63.5	63.2	62.7	62.5
21	52.5	60.5	58.2	53.2	61 5	60.5	54.2	61.	61.	57.2	59.2	61.5	59.2	59.	61.2	61.2	61.7	61.5
22	48.5	60.5	56.2	49.	61.5	59.2	50.	60.7	59.7	53.5	58.	60.7	55.7	57.	60.	60.5	60.	60.
23	48.2	61.2	57.2	48.7	61.5	59.7	49.2	61.2	60.	51.7	57.	60.2	54.	55.7	59.2	59.2	59.	59.
24	54.7	64.	62.7	54.7	64.	65.	55.	62.7	64.7	56.	59.2	64.	56.7	58.	61.7	59.	59.	59.5
25	54.	69.	66 5	54.2	69.5	68.	54.7	68.	68.	56.2	62.	66.5	57.2	59.5	64.	59.7	59.2	60.2
26	59.5	71.	72.2	59.2	68 5	73.	56.5	67.2	72.5	60.5	63.7	70.	60.7	62.	66.5	61.	61.	61.5
27	64.2	66.2	67.	63.7	66.	67.	64.	65.5	67.	64.	65.	66.	63.7	64.	64.7	62.5	62.5	62.7
28	60.	70.5	67.	65.5	68.	67.5	60.7	67.	67.5	62.2	64.7	66.7	62.7	63.2	65.2	62.5	62.7	62.5
29	66.2	68.7	62.	65.7	69.2	63.7	65.5	68.5	64.	65.5	67.	65.7	64.5	65.5	65.5	63.	63.	63.7
30	51.	60.2	59.	51.5	63.5	61.	53.	63.	61.5	56.5	60.	62.5	59.	59.5	62.	62.2	62.	61.7
31	48.5	61.5	58.	48.7	61.7	60.5	50.	61.7	61.	54.5	58.5	61 5	56.2	57.2	60.5	60.5	60.	60.

Reading of Soil Thermometers

October.	1 inch.			2 inches.			3 inches.			6 inches.			9 inches.			18 inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A, M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	48.	54.5	49.5	49.5	54.7	52.5	50.7	55.	53.5	54.	55.7	55.5	56.	55.5	56.2	59.5	59.	58.7
2	44.5	48.	48.	45.2	48.2	50.	46.	48.5	50.7	48.7	49.7	52.2	51.5	51.2	52.7	57.2	56.5	56.2
3	40.	58.2	55.	40 5	59.	57.2	41.7	58·5	57.7	45.5	52.7	57.7	48.7	51.	56.	55.	54.7	55.2
4	45.	62.5	56.	45.	60.5	58.2	46.	59.5	58.7	48.7	54.5	58.2	51.	52.7	56.5	55.2	55.	55.5
5	53.	59.7	55.	53.2	59 5	56.2	53.5	59.2	56.5	58.2	57.	57.2	55.	55.7	56.7	56.	56.2	56.5
6	50.2	62.2	58.	50.	62 7	61.	50.2	61.2	62.2	52.	57.2	62.2	53.5	55.2	59.	56.5	56.2	57.
7	45.2	61.	59.7	46.2	61.7	62.	47.2	60.5	61.7	50.5	54.	60.7	52.7	53.7	58.5	56.5	56.2	57.2
8	48.7	65.	62.5	49.	65.2	64.5	49.7	64.2	64.2	52.	58.	63.	53.7	55.5	60.5	56.5	56.5	57.
9	52.2	67.5	64.7	52.5	69.	66.7	53.2	68.2	67.	55.5	61.2	65.7	56.2	58.2	62.7	57.5	57.5	58.
10	52.5	68.5	65.	53.	68.	67.	54.	67.5	66.7	56.2	61.7	66.7	57.5	59.	63.2	58.5	58.5	58.7
11	53.7	70 2	64.5	54.2	68.7	66.2	54.7	67.7	66.2	57.	62.	63.	58.	59.7	64.7	59.2	59·	59.
12	54.7	64.7	61.7	55.2	64.	62.2	56.	53.5	62.2	57.7	60.7	62.2	58.7	59.5	61.	59.5	59.2	59.7
13	56.2	61.7	60.	56.7	60.5	61.	57.2	60.	61.2	58.2	59.2	62.2	58.7	58.8	60.2	59.2	59.2	59.2
14	58.	64.2	60.7	57.7	64.2	60 5	57.7	63.7	60.5	58.	61.2	60.5	58.	59.7	59.5	59.	59.	59.
15	55.7	53.7	49.	56.2	55.7	51 2	56.5	56.	52.	57.7	57.2	55.	58.2	57.7	56.	59.	58.7	58.5
16	39.	43.5	40.2	40.	43.5	43.2	41.7	44.	44.	46.2	46.	47.2	49.7	48·5	49.	57.2	55.5	54.6
17	35.7	38.	40.7	35.7	39.	40.7	36.5	39.7	41.7	40.5	47.	42.5	44.2	43.2	44.5	52.7	51.7	51.2
18	44.5	48.7	47.	44.5	47.7	48.	44.7	47.5	48.2	45.5	47.	49.	46.5	47.2	49.	50.7	51.	51.
19	40.	53.7	52.	40.2	53.	52.7	41.	52.7	53	43.7	49.	52.7	46.2	47.7	51.5	51.	51.2	51.5
20	47.7	62.2	57.	47.5	50.5	58.2	47.5	59.7	58.2	48.7	54.2	57.7	49 7	51.7	55.7	52.2	52.2	53.
21	50.7	53.5	48.5	51.	54.5	50.	52.5	54.7	50.7	54.2	54.2	53.	54.5	53.7	53.2	54.	54.2	54.
22	41.2	56.2	53.5	41,5	57.	55.2	43.2	56.5	55.7	45.7	51.5	55.5	48.2	49.7	53.7	53.	52.7	53.7
23	45.5	55.5	49.5	46.2	57.7	52.5	47.	58.	53.5	48.5	54.2	55.7	50.7	51.7	54.	53.	53.2	53.2
24	41.2	52.5	52.	41.5	51.	52.	42.	51.	52.5	45.2	48.7	52.	47.7	48.5	51.2	52.7	52.	52.
25	50.	55.	52.5	50.	54.5	53.5	50.	54.5	53.7	50.7	53.	54.2	51.	52.	53.2	52.5	52.5	52.7
26	43.	45.	43.7	43.7	45.5	44.	44.5	45.5	44.5	47.2	47.	45.7	49.2	48.5	48.	52.5	52.	51.7
27	43.	47.5	46.2	43.	46 5	46.	43.2	46.5	46.5	44.	46.2	47.5	45.5	47.	48.	51.	50.7	50.5
28	47.	51.	48.	46.7	50.5	48.2	47.	50.2	48.7	47.5	49.	47.5	48.	48.7	49.5	50.7	50.7	51.
29	45.5	48.5	48.5	46.	48.5	48.5	46.2	48.5	49.	47.7	48.2	49.5	48.5	48.5	49.5	51.	51.	51.
30	48.2	50.2	49.	48.2	50.2	49.	48.5	50.5	49.5	48.5	50.	50.5	49.5	49.7	50.5	51.	51.	51.2
31	46.	54.	49.	46 2	55.7	50	47.	55.7	51.	48.	51.5	52.5	49.	50.	52.	51.2	51,2	51.5

APPENDIX.

Oct. 1.

INVENTORY.

STATION FURNITURE.

Stenographer's Room.

	No.	Value.
Bedstead	1	$ 6 00
Spring bed	1	2 50
Mattress	1	3 00
Dresser	1	12 00
Wash stand	1	4 00
Table	1	1 25
Chair	1	50

Botanist's Room.

Bedstead	1	$ 7 00
Husk mattress	1	3 50
Wool mattress	1	7 00
Bolster	1	2 00
Dresser	1	13 50
Washstand	1	4 50
Table	1	2 25
Book shelves	....	8 00
Rocking chair	1	1 25
Chairs	2	2 50
Bowl	1	50
Pitcher	1	50
Soap dish	1	50
Chamber	1	75

First Assistant's Room.

Bedstead	1	$ 7 00
Spring bed	1	3 50
Matttress	1	3 00
Bureau	1	12 00
Table	1	2 00
Washstand	1	3 00
Wooden arm chair	1	1 25
Chair	1	65

Director's Office.

Table	1	$ 2 25
Gas lamp	1	1 00
Spittoon	1	50
Wooden arm chairs with cushions	2	5 50
Tin post office box	1	1 00
Mail bag	1	2 00
Harvard stove	1	10 00
Dynamometer	1	30 00
Calipers, pair	1	1 00
Cricket clock	1	2 00
Mat	1	1 00
Floor mat	1	5 00
Step ladder	1	1 00

Stenographer's Office.

Table	1	$ 3 50
Wooden arm chair with cushion	1	2 75
Common chair	1	40

Public Office.

Cherry table	1	$80 00
Gas lamp	1	1 00
Cherry chairs	10	80 00
Cherry arm chairs	2	24 00
Common chairs	2	30
Calendar clock	1	30 00
Spittoon	1	
Waste basket	1	
Mats	3	1
Two-light chandeliers	2	7 00

Entry.

One-light pendant lamps	2	$ 4 00
Water tank	1	1 00
Home-made hat racks	2	5 00

Laboratory.

Wooden arm chairs	3	$ 8 25
Stools	4	2 40
Step ladder	1	1 00
Desk table	1	25 00
Table	1	2 25

Piazza.

Settees	17	$68 00
Rubber mats	2	2 00

Men's Room.

Newark stove	1	$10 00
Table	1	2 25
Chairs	4	1 60

Miscellaneous.

Flag	1	$30 00

Stationery.

	No.	Value.
Bill blanks	475	$ 2 25
Blank books 7¼x10 inches	18	6 85
" " 4 x 8 "	20	4 00
" " 6 x 8 "	5	3 00
" " 8 x12 "	5	2 00
" " 3¾x 6 "	75	2 80
" " 8 x10 "	1	38
Blocks (drawing) 7x9 inches	2	60
Blotters	70	25
Bottles (mucilage)	3	40
Brushes	2	08
Caligraph, rather worn	1	25 00
" ribbons	6	4 50
" stand	1	3 00
Copy-holder	1	1 30
Envelopes, 3 x6 inches	1,000	3 00
" 3¾x6½ " (plain)	2,250	3 00

	No.	Value.
Gum labels, boxes	7	6 50
Ink, quarts	4	1 60
Inkstands	2	2 00
Lead pencils	120	1 80
Letter press	1	15 00
Mucilage, pints	1	25
Paper 8x10 inches, sheets	300	1 00
" (blotting) 19x24 in. sheets	3	30
" (ruled) 8 x10 " "	250	1 00
" " 7 x9 " "	100	20
" " 10½ x x8¼ "	250	1 00
" " 6 x7½ " "	1,600	2 12
" " 12 x14 " "	50	80
" " 8½ x11 " "	550	4 00
" " 6½ x7½ " "	325	1 00
" (drawing), yards	12	1 80
" (wrapping) 30 x40 in. sheets	178	3 00
" fasteners, boxes	8	2 10
Pay roll blanks	300	3 00
Pens (steel)	50	50
Ribbon reel	1	75
Rubber bands, pounds	1-2	50
Scrap books	5	4 50
Scratch blocks 6 x7½ in.	15	3 00
" " 5¾x7¾ in.	3	60
" " ruled) 8½ x11	24	4 80
" " " 8½ x11 in	7	1 40
" " " 2 x 4½.	43	2 40
" " " 2½ x 4 in.	3	18
" " " 1¼ x 3 "	32	80
Shears, pairs	2	2 00
Shipping tags	900	1.00
T squares	2	2 00
Tags	1,500	600

Botanical Department.

Camera obscura	1	$10 00
Culture apparatus for bacteria,	12	7 70
Dissection microscope (Bausch & Lomb)	1	12 00
Drying papers, sheets	340	3 40
Homogeneous 1-10 immersion objective	1	80 00
Sterilizing apparatus for bacteria	1	10 00

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Laboratory.

Articles.	No.	Value.
Acid dishes 5½ iuches	2	$ 1 25
“ jars graduated	2	2 25
“ graduate glass 500 c.c	1	55
“ “ porcelain qt	1	55
Agate mortar 4 in	1	11 50
Adapters	5	1 00
Apparatus for C O2	1	4 00
Aspirator bott!e, 2 gal	1	2 50
Analytical balance	1	50 00
Balance, druggist large		12 00
“ decimal	1	9 00
“ small		7 00
Battery jars	4	1 60
Beakers. plain, 2 litre	1	50
“ “ 1 “	1	40
“ “ 150 c.c	10	1 40
“ lipped, 500 c.c	6	2 50
Beakers, “ 250 c.c	60	15 00
“ “ 200 c.c	14	2 10
“ flasks, 500 c.c	7	2 10
“ “ 250 c.c	12	3 00
Bell glasses, 2 gal	11	22 00
“ “ 12 inch	4	8 00
“ “ 9 “	2	3 00
“ “ 6 “	6	5 00
“ “ 2 “	2	1 00
Bellows	1	5 00
Blast lamp	1	5 00
Bottles, salt mouth glass stopper, qt	60	22 00
Bottles, salt mouth glass stopper, pt	150	43 00
Bottles, salt mouth glass stopper, ½ pt	40	9 00
Bottles, tinctures glass stopper, 2 gal	6	6 00
Bottles, tinctures glass stopper, 1 gal	6	2 25
Bottles, tinctures glass stopper, ½ gal	13	4 50
Bottles, tinctures glass stopper, 1 qt	10	3 50
Bottles, tinctures glass stopper, 1 pt	21	4 00
Bottles, tinctures glass stopper, ½ pt	33	5 50
Bottles, tinctures glass stopper, 4 oz	5	60
Bottles, tinctures glass stopper, 1 oz	1	10
Bottles, tinctures glass stopper, 2 qt. green	40	9 50
Bottles, salt mouth cork, 1 gal	10	2 00
“ “ “ 2 gal	10	10 00
“ “ “ 3 qt	9	1 75
“ “ “ 2 qt	11	2 00
“ “ “ 1 qt	20	3 00
“ “ “ 1 pt	100	13 00
“ “ “ 4 oz	60	7 50
“ “ “ 2 oz	28	2 25
“ “ “ 4 oz	12	1 00
“ tinctures cork 2 qt	6	1 50
“ “ “ 1 qt	6	1 50
“ “ “ 1 pt	21	2 50
Brass tubes. 5x30 inch	6	9 00
Burette, 50 c.c	2	5 00
Burners, Bunsen	7	2 00
“ “ 3-burner	1	1 00
“ solid flame, Fletche'rs	2	3 00
“ Fletcher's	2	2 00
Cans, tin	4	50
Carboys	5	5 00
Casserols	1	50
Centrifugal machine	1	5 00
Chloride of calcium jars	12	8 50
“ “ tubes	4	75
“ “ “ for combustion	4	1 75
Clamps, large	2	2 00
Clamps, screw	4	2 00
Clips for watch glasses	4	1 00
Combustion furnace	1	20 00
Condensers	2	2 00
Copper foil, lbs	3	1 50
Copper gauze		50
Corks, assorted		10 00
Cork borers	12	1 00
Cork press	1	1 00
Crucibles, porcelain	20	4 00
Crucible tongs	2	80
Crystalizing dishes, nests	3	2 50
Cylinders, glass grad., 100 c.c	1	1 00
“ “ 10 inch	2	80
“ “ 15 inch	1	60
Colorimeter, Dubosque	1	50 00
Dessicators	2	3 00
Develaping dishes, porcelain	2	2 00
Diamond for marking	1	2 50
Diamond glaziers	1	5 00
Distilling apparatus, copper	1	2 00

Articles.	No.	Value.
Dropping bottles	2	1 25
Drying ovens, steam	1	25 00
“ “ 12x12	2	10 00
“ “ 5x8	1	2 00
Extraction apparatus	6	7 50
Eudiometer tube	1	1 50
Evaporators, glass	5	1 50
Evaporating dishes, 18 inch	1	4 00
“ . “ 15 inch	1	3 50
“ “ 13 inch	1	2 00
Evaporating dishes, 9 inch	2	$ 1 50
“ “ 6 “	7	3 00
“ “ 5 “	4	1 40
“ “ 4 “	11	3 00
“ “ 9 “	20	5 00
Filter pumps, glass	2	2 50
“ “ brass	5	1 75
“ paper, coarse		2 00
“ “ No. 597		3 00
Filters cut		6 80
Filter stands	3	2 50
Filter flasks	6	1 50
Flasks, flat bottom, 2 litre	5	1 25
“ “ “ 1 “	20	4 00
“ “ “ ½ “	13	1 60
“ “ “ 250cc	3	30
“ “ “ 200cc	24	1 75
“ “ “ 150cc	25	1 50
“ “ “ 100cc	30	1 50
Flasks, graduated 1,000cc	2	2 20
“ “ 500cc	2	1 90
“ “ 250cc	2	1 50
“ “ 200cc	2	1 30
“ “ 100cc	2	90
“ “ 25cc	1	35
Forceps	4	1 00
Fiber bulbs	11	8 00
Fruit jars	20	1 00
Funnels, 1 gal	1	1 00
“ ½gal	2	1 70
“ 1 qt	1	45
“ 1 pt	3	90
“ 3 inch	18	3 50
“ 2 inch	6	75
“ tubes	7	1 75
Gas machine	1	300 00
Gasoline, barrels	3	22 00
Gas bags, rubber	3	5 00
Glass tubing, lbs	15	10 00
Glass rod	2	1 00
Horn spoon	2	30
Horn scoop	2	30
Horn spannlas	3	45
Hydrometers	4	4 00
Ink stand	1	25
Jars, museum, 2 gal	4	4 00
Jars, museum, 2 gal	2	2 00
“ “ quart	3	1 50
“ “ pint	3	1 00
“ Neslers	15	3 00
“ glass, 2 gal	6	10 00
“ for refuse, 5 gal	1	50
Kettle	1	50
Lactometers	1	60
Lactobutyrometers	1	7 00
Lamp, alcohol	1	2 00
Lamp, gas	1	1 00
Lamp, gas drop	1	2 00
Lamp stands	5	5 00
Mercury trough	1	90
Miscroscope slides, doz	1	1 00
“ covers doz	5	50
Mill, coffee	1	9 00
Mortars, porcelain, 9 inch	1	2 25
“ “ 3 “	2	1 00
“ iron	2	5 00
Mucilage bottle	1	10
Parchment paper, lbs	2	2 00
Pinch cocks	5	1 00
Plates	12	1 25

	No.	Value.
Photographic apparatus, including camera, 3 lenses, 6 plate holders, tripod, ruby lamp, printing press and case	..	35 00
Photographic plates, 4x5, doz	1	80
Pipettes, graduated 10 cc	3	1 25
“ 5ull 10cc	5	1 25
“ “ 100cc	1	70
“ “ 50cc	1	50
Pipetts, full 25cc	1	40
“ “ 20cc	2	60
“ “ 5cc	2	40
“ “ 3cc	2	30
“ “ 2cc	3	30
Pipettes. sp. gr	3	60
Platinnm dishes and crucibles gms	545	190 75
Platinum 6oil and wire, gms	50	15 00
Potash bulbs	2	1 20
Polariscope	1	90 00
Porous jars	4	1 20
Press	1	5 00
Refrigerators, home made	2	20 00
Retort holder	1	2 00
Retorts 2 litre	5	3 75
“ 1 “	1	50
“ ½ “	4	1 50
Rubber stoppers	1½	5 25
“ tubing, lbs		7 50
Sieves 1-100—1-10	10	5 00
Separatory funnels	2	1 60
Silver dish, 280 gms	1	28 00
Shears	1	10
Stove, oil	1	2 00
Step ladder	1	1 00
Support tabe	1	3 00
Soxhlett's milk apparatus	1	15 00
Sunshine recorder	1	50 00
Test tubes, 8 inch	37	2 25
“ “ 6 “	68	2 50
“ “ 5 “	36	1 10
“ “ 4 “	10	25
Test tube holder	1	40
Test tube brushes	5	25
Test tube racks	3	1 50
Triangles, iron	8	75
Thermometer, standard	1	12 00
“ chemical	5	5 00
“ common	39	19 50
“ recooding	1	15 00
Tin foil, ½lb	..	20
Towels, doz	1	1 80
Tripod iron	1	50
U tubes	8	2 00
Viscometer		1 00
Water bath, copper, square	1	2 00
Water bath, copper, round	1	3 00
Weights, analytical	..	12 00
“ metric	..	6 00
“ avoirdupois	..	5 00
Watch glasses, 6 inch	4	2 00
“ “ 5 “	4	1 20
“ “ 4 “	12	2 40
“ “ 3 “	21	3 00
“ “ 2 ‘,	12	1 00
“ “ perforated	6	2 00
Weighing fiasks	2	50
Weighing tubes	2	40

Chemicals.

	Lls.	Value.
Arsenic	2	20
Acid, citric	1	1 22
“ oxalic	1½	75
“ boracic	4	1 40
“ carbolic	3	1 50
“ salicylic	1¾	3 00
“ galic	½	1 00
“ pyrogalic	¼	1 25
“ tartaric	1½	80
“ molybdic	½	3 00
“ fluorhydric	1	2 50

Articles.	Lbs.	Value.
Acid, chlorhydric	12	3 00
" sulphuric-	20	5 00
" nitric	30	9 00
" acetic	2	1 00
Alcohol, five gallons	5	3 75
Alcohol, absolute-	2	1 00
Asbestos	3	2 50
Alum	3½	$0 50
Albumen	....	80
Ammonium Nitrate	8	2 75
" carbonate	1½	75
" oxalate	1	1 25
" molybdate	1⅛	6 00
" hydrate	10	1 00
" chloride	1	50
" bromide	1	55
Barium carbonate	2	80
" chloride	1	25
" hydrate	1	75
" peroxide	¾	75
Benzol	1	75
Borax	2	40
Bromide	1	4 00
Charcoal, animal	8	....
Copper, oxide	4	8 00
" acetate	1	70
" sulphate	4	1 60
Cobalt, nitrate	¼	1 25
Cochineal	⅛	09
Calcium chloride	3	90
" flouride	4	40
Carbon, bisulphide	4	3 00
Chloroform	2	1 70
Citrate of iron and ammon	½	38
Emery	4	40
Ether	15	10 25
Gelatine	1	82
Glycerine	7	2 80
Guttapercha	¾	2 25
Glass wool	..	75
Glucose	3	30
Iron, powdered	3	1 50
" alum	2	1 30
" sulphate	10	40
" chloride	1	44
" sulphate	20	3 00
Indigo	¼	37
Indigotin, ¼ oz	...	2 25
Iodine	¾	2 25
Lead acetate	1	60
Lead sub acetate sol	3	60
Lead chromate	2	3 50
Magnesium chloride	1	36
" calcinee	1	70
" sulphate	¾	18
" nitrate	..	75
Mercury	70	35 00
" oxide	1	30
" chloride	5	3 30
Magnese oxide	10	1 50
Platinum chloride sol	...	3 00
Potassium chromate	1	40
" bichromate	3½	60
" ferrocyanide	¾	81
" "	¾	1 50
" sarbonate	1	1 00
" bromide	1	40
" caustic	6	1 00
" nitrate	2	20
" cyanide	1	55
" chlorate	4	88
" iodide	¼	55
" bisulphate	¾	75
" permanganate	1	80
" sulphide	2	60
Parafine	4	1 00
Rochelle salts	5	3 25
Silver nitrate	⅛	1 75
Sulphur	10	50
Sodium, acetate	1	40
" chloride	1	40
" carbonate	1	40
" bicarbonate	3	30
Sodium, nitrate	1	12
" nitrite	¾	1 00
" phosphate	1	60
" sulphite	1	25
" lime	5	3 00
" caustic, pure	5	3 75
" " common	25	3 75
" hyposulphite	1	10
Water glass	4	1 60
Zinc	8	1 60
" dust	2	80
" corbonate	1	30
" oxide	1	15

Dairy.

	No.	Value.
Shipman Engine and shafting,.	1	$131 00
Cooley creamer	1	36 00
" " cans	10	16 00
Cream guages	6	6 00
Scale, Fairbanks	1	14 00
Churns	1	6 00
Butter worker	1	2 00
Dairy salt, bbl	½	75
Oil, bbl	1	5 00
" cans	3	45
Pails, wooden	2	40
Mop	1	25
Broom	1	10
Furnace	1	42 00
Milk pails	9	5 00
" pans	17	2 00
" cans	10	7 00
Cream pails	2	2 00
Dipper	1	20
Strainer	1	50
Dish pan	1	50
Skimmer	1	10

Shop.

Anvil	1	$ 5 00
Alligator wrench	1	25
Arbor for holding saw	1	1 25
Bevel	1	50
Brad awl	1	10
Bench shears	1	3 00
Bick anvils	2	15 00
Bits, with brace, for wood	11	1 75
Chisels, cold	5	75
Chisels, for wood	8	1 50
Compasses	1	37
Crotch center	1	1 50
Chucks (for holding drills)	2	13 00
Countersink and reamer, (for wood)	1	25
Draw knife	1	50
Drill rest	1	1 00
Forge (portable)	1	12 00
Files (for iron)	10	75
Gas plyers, pair	1	40
Gimlets	2	10
Hack saw	1	1 00
Hammers: 2 riveting, 2 nailing, and 2 sledge	6	5 00
Inside callipers, (6 inch), pair	1	50
Level	1	75
Lathe (back geared screw cutting)	1	100 00
Lathe dog	1	50
Marking iron	1	1 50
Melting ladle	1	25
Miter square	1	1 00
Nippers (cutting)	1	75
Oil can	1	20
Oil stone	1	37
Pinchers, (flat nosed)	3	1 25
" (round nosed)	3	
Planes	2	1 00
Punch	1	10
Rasps (for wood)	4	50
Spur center	1	1 00
Steel center square	1	2 00

	No.	Value.
Screw drivers (one handle).....	4	75
Saws, rip and cross cut.........	2	2 75
Stencil plates, brass....	2	2 50
Soldering irons	3	90
Square (large).........	1	1 25
Saw, back...	1	75
Tinner's shears.......	1	1 50
Turning tools (for wood).......	9	2 70
Tongs, pair..................	2	1 50
Twist drills..................	30	3 40
Try square....................	1	20
Turning tools for metal........	7	1 75
“ “ brass........	19	4 00
Vise	2	8 00
Vise	1	3 00
Wrenches, monkey......	3	1 20
Washer cutter................	1	45
Wing callipers, 8 inch, pair....	1	75
Wire gauge..........	1	1 25

LIST OF HORTICULTURAL TOOLS AND SUPPLIES.

Article.	Description.	No.	Value.
Bags, cloth...	1½ peck, peck and ½ bushel...	150	10 50
“ paper..	1 pint...........	319	4 75
“ “ ..	⅔ pint....	812	6 12
“ “ ..	½ “	938	4 60
“ “ ..	¼ “	550	2 75
“ “ ..	⅛ “	1,862	6 00
“ “ ..	1-16 pint........	1,788	3 00
“ “ ..	1-32 “	465	50
Budding knife	....	1	15
Cyclone nozzle	for distributing insectides	1	75
Garden engine	....	1	18 00
Germinating apparatus...	box lined with lead pipe	1	5 00
“	copper pans....	11	10 00
“	galv.-iron pans.	2	40
Hoes..........	wheel hoe “Ruhlman ”..	1	2 00
“	5 in. scuffle nearly new...	4	1 20
“	6 in. scuffle nearly new...	1	45
“	farm (onsiderably worn)...	3	50
“	farm hoe, nearly new........	1	60
“	small garden...	2	60
	flower garden..	1	40
Hot Bed frames......	6x13 feet with sash	3	15 00
“	6x12 feet with sash	3	14 60
Lath screens..	for hot bed frames 3x6 ft.	8	3 50
Insectides.....	Buhach powder lbs.........	5	3 50
	Paris green, lbs.	12	3 00
	Slug shot, lbs...	10	50
Lawn edger...	....	2	2 00
Lawn mower..	“ Philadelphia,” much worn...	1	1 50
Measures	gallon, tin	1	40
	quart, tin	1	12
Potato hooks..	....	1	60
Pruning tools.	hedge shears...	1	1 00
	knives	2	60
	pole shears.....	2	1 40
	pruning shears.	2	75
	saw............	1	50
	“ damaged...	1	10
Rakes.........	18 inch.........	1	60
	15 inch.... ...	2	90
	12 inch....... .	1	45
Reels, garden.	....	4	3 00
“	small, with measuring chain attached..........	2	1 50
Roller	cast iron garden	1	10 00
Sampling tool,	for soil experiments	1	2 00
Seed packet boxes	....	50	20 00
Sieve	Clough's adjustable	1	2 00

Article	Description	No	Value
Sifting box...	for distributing insectides, small, tin	1	20
	for distributing insectides, larger, galv.-iron	1	1 25
Spade.... ...	....	1	60
Spading fork.	.. ..	1	75
Articles.	Description.	No.	Value.
Stakes(unused	34 inch, 1¼x2 in. oak	435	4 00
Stakes(unused	15 inch, ½x2 in. oak	382	2 90
Stakes(unused	12 inch, pine....	732	6 00
‘ “	8 “	1012	7 00
“ “	6 “ ...	2835	11 00
“ “	3 “	693	2 00
Tape line	50 feet	1	50
Trowels	Extra heavy...	6	2 40
Weeding hooks	“ Excelsior” ...	6	75
Wire baskets .	copper, for soil experiments.	3	1 80
Wire cloth....	brass, for germinators, sq. ft..	1	20

Green House.

Article	Description	No	Value
Bellows	Large, for powder	1	2 00
Bellows	small, for powder	1	1 50
	for atomizing ..	2	1 50
Broom	....	1	25
Chairs	common, some damaged	4	1 60
Force-pump ..	2½ inch cylinder	1	5 00
Fumigator....	sheet-iron	1	50
Germinating boxes	copper. with pans..........	12	15 00
Hose..........	20 ft. long, with nozzle	1	3 15
Incubator	for germinat'n, with electric attachment...	1	15 00
Kettle.........	Iron, for warming water.....	1	3 00
Lamp.........	....	1	1 00
	extra for incubator	1	1 00
Oil can........	for kerosene....	2	15
Pans	extra, for germinat'g boxes copper........	5	6 25
Paper files	....	4	40
Pots	12 inch.........	17	2 00
	8½ inch	32	1 92
	8 inch...........	43	2 58
	7 inch	45	2 25
	6 inch	736	33 00
	5 inch	109	3 00
	4 inch	1157	30 00
	4½ inch (deep)..	10	20
	3½ inch	686	5 00
	3 inch	977	7 00
	3 inch (deep)....	10	10

Article	Description	No	Value
Pots	2½ inch	660	3 30
	2 inch	1108	5 00
Pot brackets		12	1 00
Saucers	8 inch	2	25
	6 inch	2	16
	5 inch	3	18
	square, 11 in	17	7 00
	round, 12 in	9	1 90
	brick, round 9½ inch	7	1 00
	brick, round, 8 inch	8	1 00
Shovel	coal	1	75
Sprinklcr	copper	2	1 50
Syringe	brass	1	3 00
Table	common with drawer	1	1 50
Window glass	8x10 (lights)	24	1 00

LIST OF FARM TOOLS AND AGRICULTURAL IMPLEMENTS.

Articles	Descriptiou,	No.	Value.
Axes		3	80
Auger	post hole	1	2 00
Barrows, wheel		4	1 25
Beetles,		3	2 00
Chains	log	2	1 68
Corn dropper		1	1 50
Cradles		3	6 00
Crowbars		4	1 75
Cultivator, one-horse	"Canandaigua"	1	6 00
	iron frame	2	8 00
	harrow tooth	1	3 00
Cultivator two-horse	"Ansleys"	1	30 00
Cultivattor wings and blades	for use on iron cultivator	7	2 00
Drill, grain	"Empire," small size	1	70 00
	"Crown small size	1	72 00
Flails	home made	2	20
Fork, barley		4	3 00
" c'rn shov'l		1	3 00
" dung	common 4 tined.	3	2 25
	common 6	2	2 80
Dung fork, damaged		2	30
	spading	1	60
Grain drill regulator	wheels	6	3 00
Grindstone and frame		1	2 00
Hammer		2	70
Hatchet		1	0 30
Harrow	common	1	10 00
	LaDow's	1	25 00
	com'n smoothing	1	15 00
Hay cutter		2	50 00
Hoes		10	1 00
Hooks, potato		2	1 10
Knives, corn		5	5 78
Knives, hay		3	89
Lanterns	common tubular		2 00
.,	flash	1	1 75
Lawn edgers		1	1 75
Mattocks		4	2 75
Measures	half bushel	2	80
	peck	2	40
Mill,' fanning		1	15 00
" sorghum		1	20 00
Mowing machine	Osborne No, 1, very m'ch w'n	1	15 00
Oil can		1	10
Pails	galvanized iron.	8	4 50
	drinking keg and cup	..	1 25
	water	3	1 00
Pick axes		4	3 00
Pitch forks	three tined	7	2 80
	two tined	4	1 40
Plow	export	1	35 00
	Oliver chilled New	1	14 00
Plow	iron beam	3	12 00
	Oliver Chilled, new	1	14 00
	side-hill and six points	1	10 00
	wooden beam	1	4 00
	single Syracuse.	1	7 00
Plow frame, sulky		1	25 00
Rakes	iron garden	5	1 87
	horse, Bradley wire tooth	1	15 00
	lawn	2	1 20
	wooden	5	50
Coller	two-horse iron	1	75 00
Root cutter		1	5 00
Saws	wood.	2	1 25
cross cut		1	5 00
Scoop	grain	1	1 00
Scythes		3	3 00
Sheller, corn		1	16 00
Shovels	long handles	7	1 75
	short handles	5	3 00
	snow, wooden	2	30
	scoop	2	2 00
Sickles		8	50
Spades	long handle.	2	1 75
	short handle	4	1 60
Stamp branding		1	1 00
Stone boat		1	2 50
Trowels	masons	2	40
Trucks' pr		1	14 00
Whet stones		3	30
Wrenche s		2	1 00
"	monkey, etc.	3	1 00

LIST OF LIVE STOCK AND TEAM EQUIPMENTS.

Articles.	Description.	No.	Value.
Blankets	horse	4	$ 4 00
Brooms	common	9	2 40
	stable	2	50
Brushes	card	5	3 75
Carriage	3-seated democrat	1	100 00
	2-seated democrat	1	50 00
Cows	4 Jerseys, 2 natives	6	450 00
Calves	2 Jerseys	2	20 00
	yearling, 2 Jerseys, 1 native.	3	40 00
Curry-combs		3	60
Dump boxes		2	5 00
Halters		5	3 75

Articles	Description	No	Value
Harness	double, for carriage, set	1	50 00
Harness	double working sets	2	50 00
	single driving	2	40 00
Harness extras	1 pr. lines	2	2 50
	1 breechen	2	2 50
	2 holdbacks	2	2 00
	1 collar	2	2 75
Horses	3 work, 1 driving	4	800 00
Jack, carriage lifting		1	1 00

Articles	Description	No	Value
Muzzles, wire		3	60
Nets, fly	leather	4	3 00
Rack	hay	2	5 00
Sleigh	bob	1	15 00
	driving	1	50 00
Straps	calf	4	1 40
Wagons	farm	3	140 00
Whiffletrees (in sets		3	6 00
Yokes	neck	2	1 00

MISCELLANEOUS SUNDRIES.

Articles.	Description.	No.	Value.
Baskets	2 bushels	6	$ 3 00
	clothes, 4½ bush	2	1 80
Fertilizer	sulphate potash lbs	650	9 75
	muriate potash lbs	215	2 15
	nitrate potash lbs	211	5 27
	acid phosphate lbs	400	
Hay	(tons)	75	700 00
Hod	coal	1	75
Hose (with noz)	rubber ¼ inch (feet)	49	5 65

Articles	Description	No	Value
Manure	barn yard, cords	25	75 00
Measures	tin	2	30
Nails	(lbs)	80	2 50
Oats	(bush)	600	200 00
Post	fence	100	30 00
Pulleys		3	1 50
Rope	⅝ in. lbs	15	45
Salt	(bbl)	½	50
Straw	(tons)	30	150 00
Tiles	3-inch	450	11 25
Tongs	ice	1	1 25
Wedges	iron	3	50
Wire	for fencing, lbs.	28	1 68

INSTRUMENTS.

Articles.	Description.	No.	Value.
Gauge	rain	1	$ 7 00
Scales	Jones' platform	1	60 00
	Jones' small platform	1	20 00
	Fairbanks' silk.	1	16 00
Thermometers	maximum	2	12 00
	minimum	2	8 00
	Standard	2	3 00
	Soil, 1, 2, 3, 6, 9, 18 inches	6	32

Articles	Description	No	Value
Surveying instruments	transit	1	125 00
	chain	1	3 00
	tape measure, 100 feet	1	2 50
	Wire pins	21	2 00
	Drawing boards	6	3 00

INDEX.

A. PAGE.

- Age of seed germinations 50
- Agricultural experiments 5
- Alfalfa 135
- Alkekengi 268
- Alsike 137
- Analyses, fodder 374
- Atavism in plants 54

B.

- Babbott feed 363
- Bean 160, 266
- Beet 246
- Bibliography of pear blight 300
- Blackberry 272
- Blooming of plants 3
- Botanical notes 54
- Butter adulterations 336
  - analysis 330
    - methods of 334
  - soaps, viscosity of 338

C.

- Cabbage 185
  - history 55
- Cattle feeding experiment 23
- Carrot 248
- Celery 255
- Cereal statistics 113
- Compact vs. loose seed-bed 133
- Corn, classification 58
  - experiments 41
  - preparation of land for 41
  - salad 160
  - seed 40
- Cows, excrement from 19
  - water drank by 20
- Crops vs. temperatures 38
- Cucumber 252
- Currant 273

D.

- Dewberry 273
- Digestion, pancreatin 359
- Disease of clover leaf weevil 291
- Donors, list of 15

E.

- Early planting 9
- Egg plant 161, 257
- Excrement, how much per cow 19

F. PAGE.

Feeding-stuffs, examination of ... 358
Fertilizer ... 345
  and corn ... 43
    Fodder corn ... 47
Food, Royal stock ... 361
Fodder corn ... 46
Forage corn ... 46
  Plants ... 135

G.

Germination tests ... 51
Gooseberry ... 274
Grape ... 171
Grasses ... 138

H.

Herbs ... 268

I.

Index of cabbages ... 236
Insecticides ... 174
Insects ... 174
Inventory ... 388

L.

Lettuce ... 241
Lysimeter ... 346

M.

Maize classification ... 58
Mangold ... 247
Melon ... 163, 250
Meteorology ... 6
Milk yield vs. distance from calving ... 21
Milk viscosity ... 323

N.

Newspapers received ... 18

O.

Oats ... 97
Okra ... 161, 265
Onion ... 164, 250
Orchard ... 168

P.

Parsley ... 162
Pea ... 263
Pear blight ... 275
Peppers ... 258
Plum-leaf fungus ... 293
Pollen, influences of ... 179
Potato experiments ... 48, 150
  variety tests ... 142
Ptomaines in corn meal ... 362
Pumpkin ... 255

R.

PAGE.

Races of corn 59
Radish 249
Raspberry 271
Report, the Assistant Chemist's 358
    Horticulturist's 246
  of the Board of Control 1
  the Botanist's 275
    Chemist's 316
    Director's 3
    First Assistant's 67
    Horticulturist's 141
    Treasurer's 2
Root growth 159
Root pruning 165
Rotting of tomatoes 289

S.

Seed corn 40
  vitality 50
Seedling fruits 170
Seeding periods 132
Smut in oats 125
Soil moisture 180
Squash 162, 254
Strawberry 269
  mildew 291
Sunlight considerations 8
Sunshine record 348
Sweet clover 136

T.

Temperature, sums of 4
  vs. crops 38
Theories 11
Tillering 117
Tomato 172, 261
  rot 289
Transplanting 196
Turnip 163

V.

Variety description, cabbage 198
  tests 66
Viscometry 316

W.

Water, amount drank by cows 20
Watermelon 250
Weather summaries 4
Weeds in corn 46
Weed statistics 298
Wheat classification 69
  selection 134
  trials 69
  varieties 69
Wild potatoes 149

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